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VOL 95 No 4

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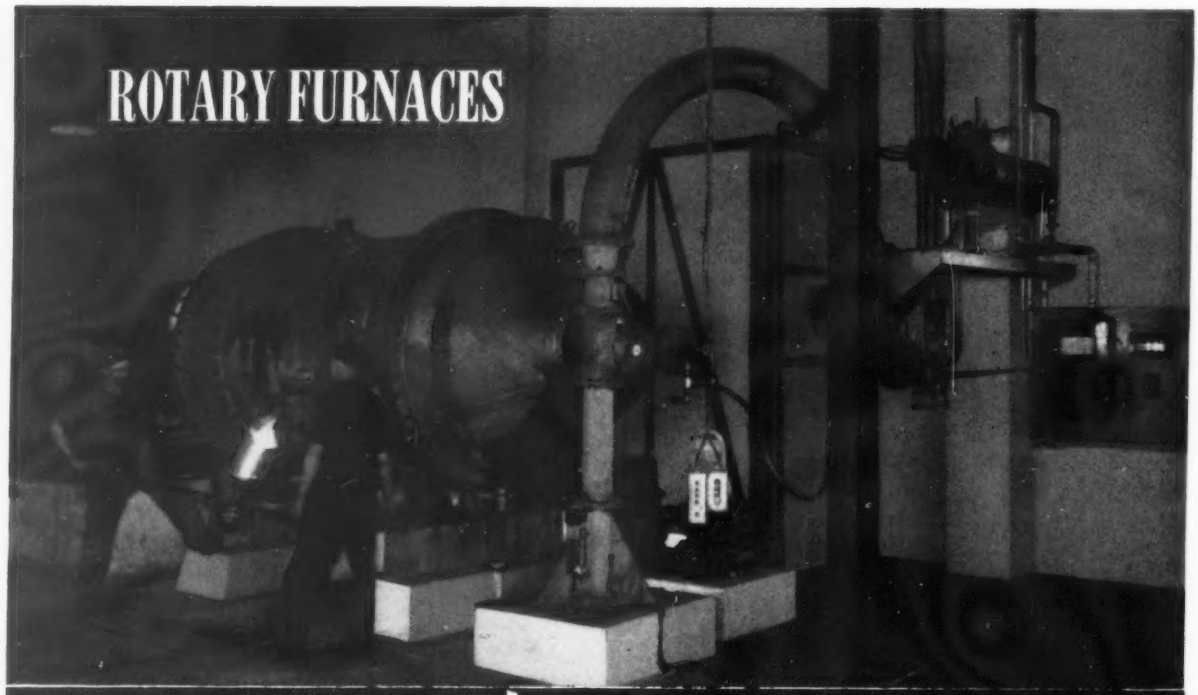


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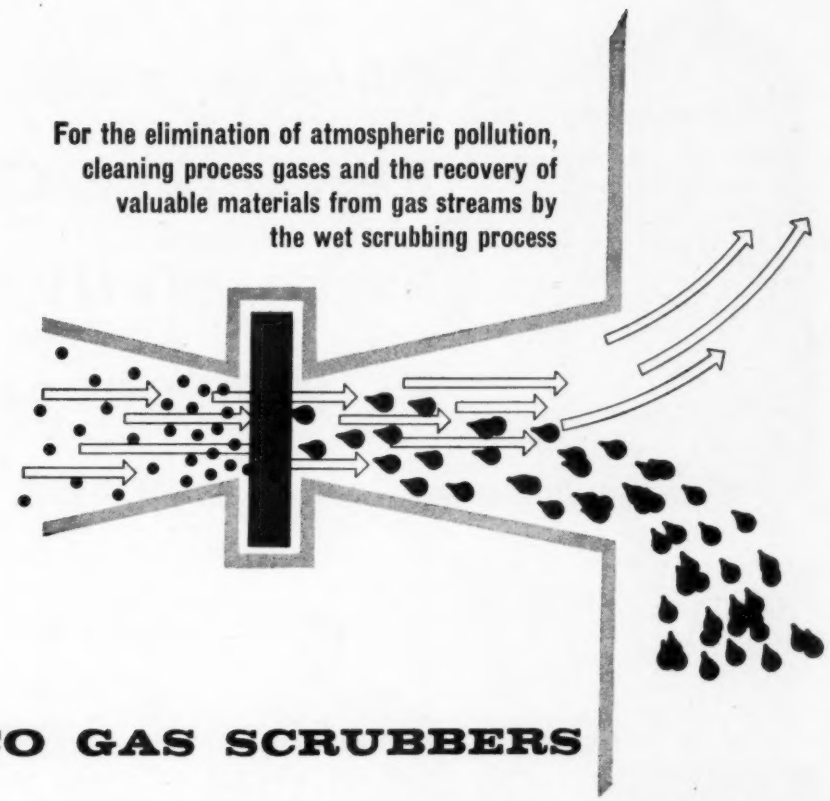

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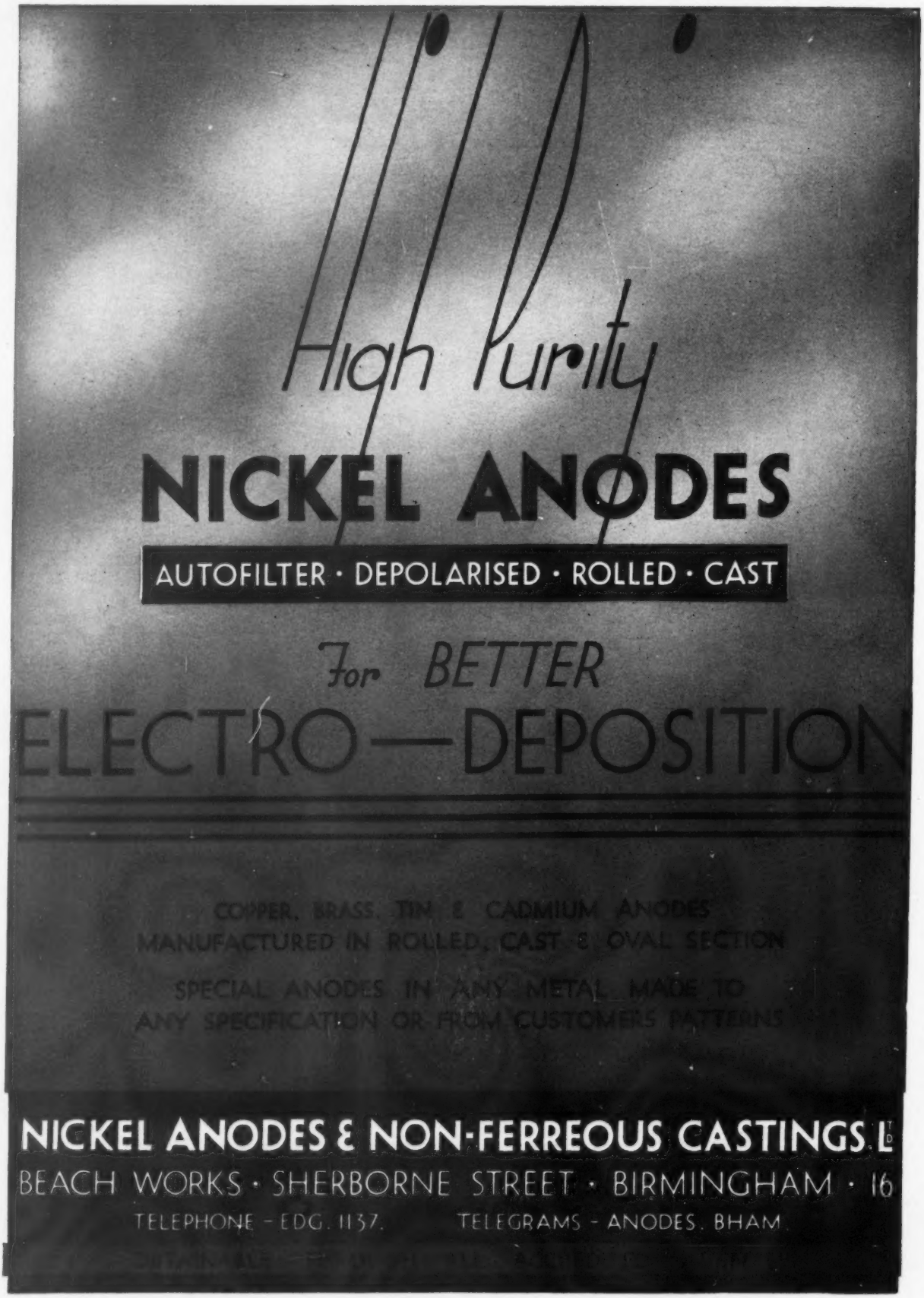
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*Electrical Aids in Industry* *Data Sheet* **No. 6**

# Lighting-1

Good lighting affects productivity in three ways, (1) by directly increasing the speed of working and reducing errors and wastage, (2) by improving overall factory efficiency through better supervision and housekeeping, (3) by providing better working conditions, thus improving labour relations and avoiding frequent changes of workpeople.

It is not possible to judge by the eye alone whether the lighting in any factory is good enough to serve these purposes because the eye has a tremendous range of adaptation (vision of some kind is possible within an illumination range of 1,000,000 to 1) and is hence an unreliable measuring instrument. Severe mental and eye strain or unconscious slackening of working speed may occur under lighting which *appears* to be adequate.

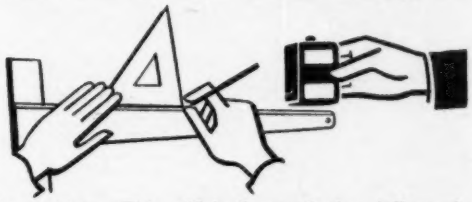
The only reliable way to appraise factory lighting is to conduct a lighting survey using a lightmeter, an inexpensive instrument which measures the actual illumination available. These figures can then be compared with official recommended values for the various tasks.

### *Lighting Survey*

A methodically conducted lighting survey is the first step towards achieving good productive lighting. The average artificial illumination at working height should first be measured. This requires a number of readings at various positions relative to the lighting fittings, particularly beneath and between fittings and by the wall. The average of the readings should then be compared with the illumination values recommended by the Illuminating Engineering Society. The following is a general guide to illumination requirements.

| NATURE OF WORK, PROCESS OR MATERIAL | ILLUMINATION LUMENS/SQ.FT. |
|---|---|
| Rough or routine work. Large detail. Medium to light material of good contrast. | 7 |
| As above, but work rather more skilled or critical. | 10 |
| Ordinary work usually involving workers' inspection. Medium detail and contrast. | 15 |
| Fairly critical work, fairly small detail or poor contrast. | 20 |
| Skilled work, small detail or dark material. | 30 |
| Fine or critical work, very small detail, very poor contrast or very dark material. | 50 |
| Very fine exacting work. | 100 |
| Minute work. | 200 |

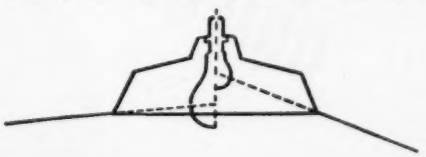
In addition, readings should be taken at selected working points with the lightmeter so placed that it measures the light on the work while the operative



is working. This will indicate whether full use is being made of the light or whether shadow is obscuring part of it.

### *Glare*

Any direct light on the eye tends to reduce its sensitivity—thus reducing the power to see. Increasing the intensity of the light source may



therefore not improve matters unless care is taken to avoid glare either by correct positioning or by the use of correctly matched reflectors and lamps.

### *Walls and Ceilings*

Certain surfaces and certain colours absorb light and therefore do not make the best of a light source; others reflect light and, so to speak, feed back on to the work a portion of the lighting which would otherwise be lost. Bright walls, moreover, have a good psychological effect which makes for contented —and therefore productive—operatives.

### *Shadows*

Unnecessary shadows may seriously slow down work and also cause accidents. Lightmeter readings should always be taken under conditions exactly similar to those obtaining while work is going on. The operative himself may mask his work, an overhead crane or a heavily loaded conveyor belt may periodically obscure a light fitting, or a dust-laden atmosphere may reduce the designed lighting values.

For further information, get in touch with your Electricity Board or write direct to the Electrical Development Association, 2 Savoy Hill, London, W.C.2. Telephone: TEMple Bar 9434.

Excellent reference books are available on electricity and productivity (8/6 each or 9/- post free)—"Lighting in Industry" is an example.

E.D.A. also have available on free loan in the United Kingdom a series of films on the industrial uses of electricity including one on industrial lighting. Ask for a catalogue.

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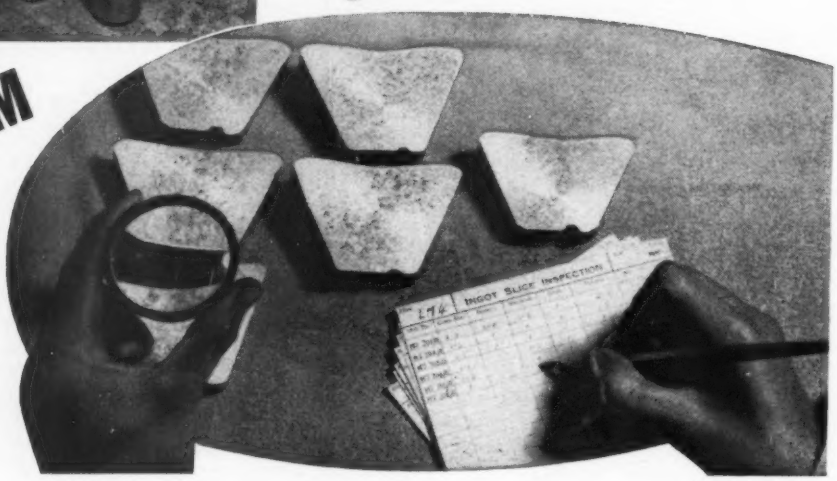


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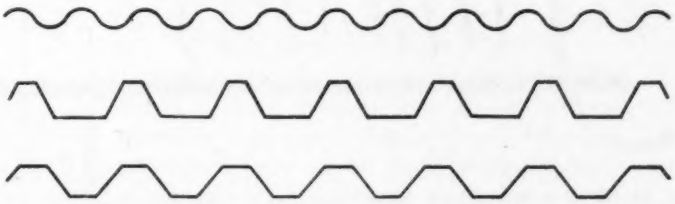

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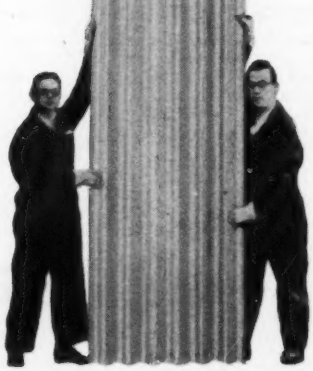

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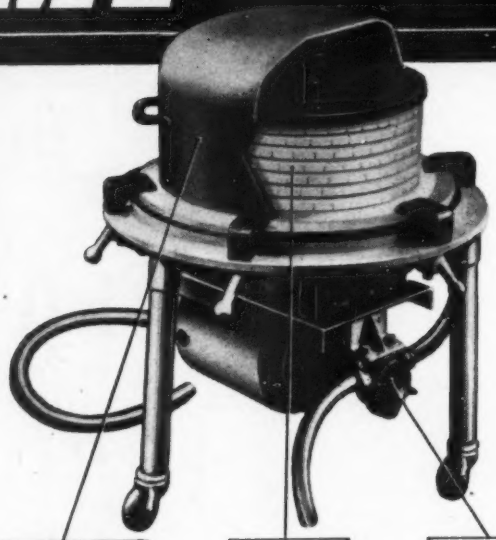

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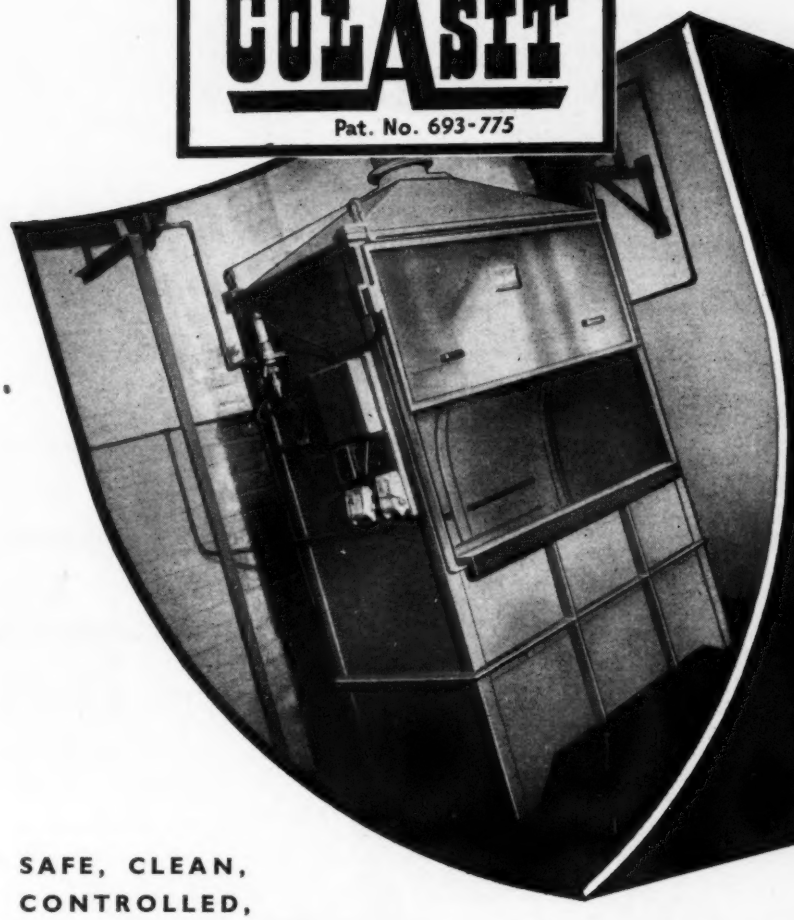

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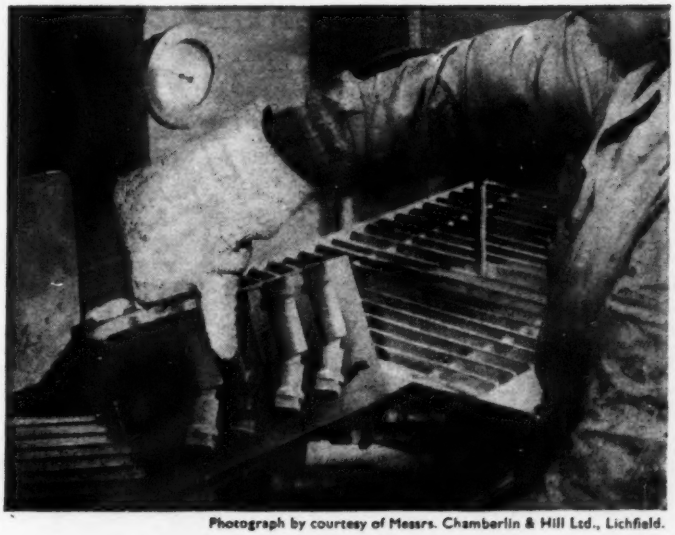

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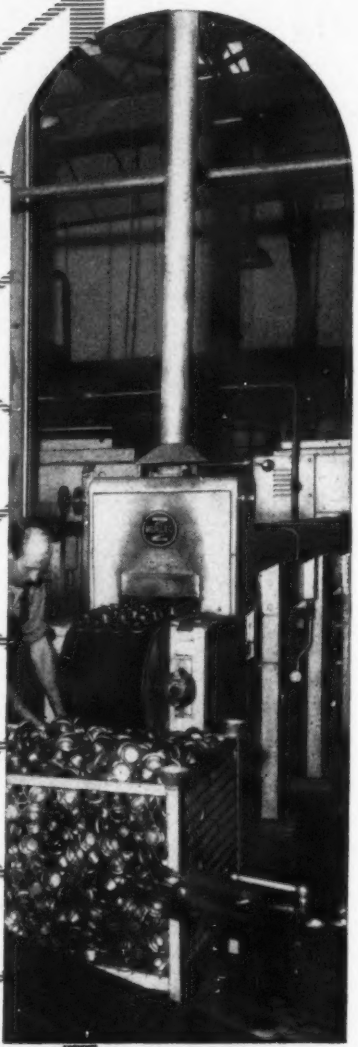

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# METAL INDUSTRY

FOUNDED 1909

EDITOR: L. G. BERESFORD, B.Sc., F.I.M.

4 SEPTEMBER 1959 VOLUME 95 NUMBER 4

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**PUBLISHED EVERY FRIDAY BY ILIFFE & SONS LIMITED**

Editorial Offices: 9 Charlotte Street, Birmingham 3 . Telephone: Central 3206

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METAL INDUSTRY

VOLUME 95 NUMBER 4 4 SEPTEMBER 1959

# Creep Information Centre

DATA on the strength properties of high-temperature materials are so voluminous and so widely scattered throughout the literature that it is becoming increasingly difficult for industrial designers to keep abreast with the information available. Because of this, and because of their present and future importance, it has been decided to set up a Creep Information Centre at the National Engineering Laboratory in order that the information may be made readily available to industry from one source.

In the first place it is intended to collect and tabulate all the available data on creep and rupture properties of conventional high-temperature materials. Later, data on all mechanical properties of these materials and information about test procedures and testing machines will be added; data on foreign materials may also be included. It is envisaged that the present functions of the Centre are to collect experimental data on creep and other mechanical properties of high-temperature materials in the form of original curves and laboratory reports, published Papers, catalogues and trade literature. These data will then be tabulated and made available to industry. British and foreign specifications for standard high-temperature materials will also be collected and tabulated. In addition, details of British and foreign testing machines for high-temperature work and information about test procedures will be accumulated. From this information lists of references on particular aspects of high-temperature testing and mechanical properties will be produced, and a manual be prepared on the testing of high-temperature materials.

Further, it is intended to organize, from time to time, discussions on high-temperature test procedures. Contact is to be maintained with all committees in the United Kingdom concerned with high-temperature materials, and a technical liaison officer is to be appointed to keep in contact with all British high-temperature laboratories, with a view to co-ordinating the development of testing equipment and techniques. A summary of the major projects and test programmes of British high-temperature laboratories will also be prepared. In order to foster international co-operation in investigating problems relating to the use of engineering materials at high temperatures, contact is to be made with overseas organizations concerned with these matters. Lastly, it is proposed to establish a museum of high-temperature failures by collecting samples (with case histories) of failures of high-temperature materials from industry and other organizations.

Naturally, it will be some time before the scheme becomes fully effective, but it is hoped that eventually the Centre will become the national source for data on the mechanical properties of British and foreign high-temperature materials and test methods. The ultimate success of the scheme will depend on the co-operation of all producers and users of high-temperature materials who, by supplying experimental data and thus pooling their information, can enable high-temperature data for British materials to be published in an agreed form so far as considerations of commercial security allow. Such co-operation will surely be readily forthcoming.

# *Out of the* MELTING POT

**Inherently Anti**

COPPER-BASE alloys of the types used for the manufacture of condenser and heat-exchanger tubes, marine hardware and shafts, ferrules, valves and other components which come in contact with sea water are liable to suffer various well known forms of attack which gradually weaken the alloy and ultimately cause failure of the equipment. These forms of attack include dezincification of the uniform and pitting types. In addition, impingement corrosion may occur where the metal is exposed to turbulent flowing water. In the presence of internal stresses in the metal and of ammonia or ammonium compounds in the surrounding medium, the alloys may suffer from stress corrosion or, as it is more commonly called, season cracking. Finally, under suitable conditions, the surface of the copper alloy parts may become covered with a layer of organic slime or algae. Decomposition of these gives rise to ammonia necessary for season cracking, while the presence of the layer of organic slime as such will reduce the efficiency of heat transfer of brass tubes in heat exchange equipment. Hitherto, the formation of algae has been retarded or prevented by chlorination of the water. It is not an improbable speculation that the knowledge of the use of various mercury compounds in anti-fouling paints (which, of course, could not be used for this purpose on heat exchanger tubes) led to the idea of utilizing the anti-fouling effect of mercury by incorporating the mercury in the copper alloy. This has led to claims for an anti-fouling Admiralty metal consisting essentially of approximately 70 per cent copper, 28 per cent zinc, 1 per cent tin, and mercury in an amount between 0·001 and 1 per cent, and, more generally, for copper-base alloys containing 59 to 85 per cent copper, 15 to 40 per cent zinc, and 0·001 to 1 per cent mercury. Such alloys containing mercury have been found to resist fouling and to remain bright and clean in conditions in which fouling would normally occur on alloys of the same composition but not containing mercury. Any slime that may form adheres poorly to the surface and can be readily rinsed off. Furthermore, however, the addition of mercury to copper-base alloys has been found to produce a substantial improvement in general corrosion resistance and impingement corrosion towards sea water, as well as improved resistance towards dezincification.

**Somewhat Delayed**

PUSH-BUTTON retrieval of information may be all very well if and when it becomes available. In the meantime, retrieval of information remains a matter of hard work or fortunate chance. Take, for example, the chance encounter the other day in the July, 1944, issue of *Metal Progress* (pp. 102-103) with the following paragraph with which L. R. Carl concluded a letter to the readers of the journal, in which he described the results of an examination of a weld between two brass discs. The weld had been produced by a detonation impulse. The specimen had been recovered during routine tests of explosives in no way intended to produce welding between the two brass discs, which merely formed part of the set-up for testing the explosives. The weld had, therefore, not been formed intentionally, and the surfaces of the brass discs had not been prepared in any way to facilitate welding. After speculating on the mechanism (loosening of the crystal structure of the metal by the detonation impulse or ultrasonic vibrations) by which welding of the two brass surfaces had occurred, the writer concludes by saying that it seems to him "that it would be worth while to investigate metals which have been especially prepared to facilitate welding with explosive charges, and also with ultrasonic waves of known frequencies, to determine the exact conditions under which the various metals would join together." It may be deduced that readers of *Metal Progress* at that time did not include anybody now concerned with ultrasonic welding, for otherwise how explain the fact that it has taken getting on for fifteen years "to determine the conditions under which the various metals would join together."

**Getting There**

A STEEL containing 1·5 to 1·6 per cent carbon and 0·5 to 2·0 per cent silicon, balance iron, with or without various alloy additions, is heated for about 20 hr. to a temperature within the range of 650°C. to 1,100°C., the actual temperature selected within this range being lower the higher the silicon content of the steel. The steel is then furnace-cooled at a rate of about 25°C/hr. to about 400°C. The steel is then heated a second time to a temperature of about 750°C. for about 25 hr. and then permitted to cool at a rate of about 60°C/hr. to about 400°C. The steel is then subjected to a third heat-treatment, in which it is heated to about 750°C. to 850°C. for about 1½ hr. and permitted to cool at a rate of about 50°C/hr. This third heating and cooling cycle is then repeated for a total of about forty times. Without any further explanation, the above elaborate multiple heat-treatment might well be taken as being intended for use in connection with a study of some extremely sluggish microstructural changes. Alternatively, it might be thought of as being intended to provide a test simulating service conditions in which the steel would be subjected to repeated heating and cooling, and, as a result, might suffer from thermal fatigue or some other process of progressive deterioration. One would certainly hardly realize that in actual fact the purpose of this prolonged sequence of heat-treatments is that it constitutes a recently invented method of producing an oil-permeable steel for use in oil-less bearings and the like. The first two prolonged high-temperature heat-treatments have the effect of precipitating some of the carbon of the steel as graphite. The repetition for a sufficient number of times of the third heat-treatment has the effect of producing "growth," with the formation of interconnected cracks at the grain boundaries of the precipitated graphite. This effect, which had previously been observed in cast iron containing free graphite, produces a porous steel capable of being impregnated with about 5 per cent of oil by volume. Compared with cast iron with porosity developed by a similar treatment, the porous steel is much stronger and more ductile. It just remains to add that the description of the invention has nothing to say as to how the material and the process by which it is attained compare with porous materials and the process of producing them by compacting and sintering ferrous metal powders.

Skimmer

**Finishing Supplement**

# Levelling in Bright Nickel Baths

By Dr. S. E. BEACOM and B. J. RILEY

*In pursuit of a programme aimed at a better understanding of the mechanism by which organic addition agents influence the electrodeposition of nickel the technique of labelling the organic compounds with radioactive isotopes was utilized. Confirmation is obtained for a theory which accounts partially for levelling action in the type of bright and levelling nickel solutions considered in this study, carried out at General Motor Research Laboratories.*

IN the sequence of events which leads to the production of brilliant, chromium plated automobile parts, the chromium must be deposited on a bright and smooth nickel surface. Such a surface may be produced by buffing a matte or a semi-bright nickel deposit. As an alternative, it is possible to deposit directly, from baths containing organic addition agents, a nickel plate which is bright and which also tends to fill in the micro-irregularities of a surface to make it smooth. From the standpoint of economics, it is readily apparent that any process which eliminates buffing operations is desirable.

## Levelling

The recognition that certain plating solutions can deposit more than the expected amount of metal in the small recesses of scratches in the basis metal to produce a smoother surface was reported by 1940 and also recognized in the patent literature, prior to the noteworthy contribution of Gardam[1] in 1947. Although this phenomenon subsequently has been known by a variety of terms, such as *smoothing action* and *hiding power*, it will be referred to here as *levelling*.

Levelling has been defined by Thomas[2] as the ability of an electroplating solution to produce deposits relatively thicker in small recesses and relatively thinner on small protrusions with an ultimate decrease in the depth or height of the small surface irregularities. If an irregular surface is considered to be a series of peaks and recesses, then any action which deposits more metal in a recess than on a peak contradicts normal plating expectancy. In normal plating, more metal would be deposited on the high current density areas which are the high points, or peaks, of an irregular surface. For a comprehensive review of the whole problem of levelling, the report of Leffler and Leidheiser[3] is most informative.

There has been much speculation concerning the mechanism by which the phenomenon of levelling may occur in the electrodeposition of bright nickel. The situation is complicated by lack of agreement among investigators as to the effect on levelling of various plating conditions, including current density, temperature, agitation, and addition agent concentration[2,4-7]. There is, however, general agreement that an increase in polarization accompanies levelling action [4,6-12].

Some theories of the phenomenon assume that an organic addition agent which promotes levelling is adsorbed or co-deposited upon the high points, or peaks, of an irregular surface[2,4,7-12]. This adsorbed material presumably leads to localized polarization which partially inhibits the deposition of metal at the peaks and diverts current flow to recessed areas. Recent work of Watson and Edwards[7] supports this view. They show conclusively that there is increased polarization in solutions possessing levelling ability. Further, they apparently have identified the presence of addition agents in nickel deposits by a staining technique which, for example, caused a darkening on the peak areas of a deposit obtained from a bath containing thiourea. In his study of laminations, Vanderkooi[15] considers that the dark bands present in deposits contain either included addition agents or their reduction products. These observations emphasize the need for a technique which will show unambiguously the location of addition agents in levelling nickel deposits.

With the particular solutions used in this study, the deposits formed are laminated in structure. Metallographic examination of such deposits shows alternate light and dark bands which apparently have been produced by some type of rhythmic process. The mechanism by which these laminations are produced is not clearly understood. While it is known that levelling can be achieved in unlaminated deposits, a theory which can account at least in part for levelling must be compatible with lamination formation.

The purpose of this study was twofold: first, to determine if an organic agent known to promote levelling was preferentially adsorbed or co-deposited on the high points of an irregular surface and, second, to develop radiotracer techniques suitable for determining the location, within electrodeposits, of a radioactive organic addition agent.

The work of Vanderkooi[15] has shown that the brightener system of sodium allyl sulphonate[16] and N-allyl quinaldinium bromide[17] produces bright, levelling, and laminated nickel deposits. These organic addition agents were used in a Watts-type nickel bath to produce the electrodeposits examined in this study. The sodium allyl sulphonate was radioactive due to the use of the beta emitting S-35 atom in its synthesis. To examine the deposits for the presence of radioactivity it was necessary to develop counting and autoradiographic techniques.

## Synthetic Radioactive Agent

The micro-synthesis of sodium allyl sulphonate containing the radioactive isotope S-35 was one reported by Hoekstra.[18] The metathesis reaction was carried out between allyl bromide and sodium sulphite containing S-35 as the labelled atom. One-millimole amounts of each of the reactants were

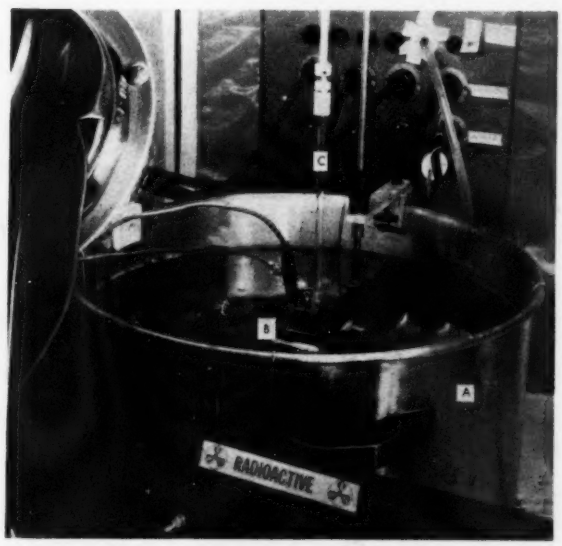


*Fig. 1—The plating apparatus used in the study of levelling effects was contained in a glove box to prevent the spread of radioactivity. A constant temperature water bath* A *was used to maintain a temperature of 56° to 58°C. The plastics cell* B *contained the plating solution, nickel anode, and serrated brass cathode. An agitator rod* C *was connected to an oscillating stirrer outside the glove box*

**TABLE I—PLATING CONDITIONS AND RESULTS**

| Foil Number | Plating Time (min.) | Amp | Current Density (amp/ft²) | Brightener Concentration (mg/mL) | | | Result |
|---|---|---|---|---|---|---|---|
| | | | | No. 1 Active | No. 1 Inactive | No. 2 Inactive | |
| 21 | 100 | 0·3 | 27·3 | 3 | 0 | 0·6 | Foil intact, dull |
| 25 | 100 | 0·3 | 27·3 | 6 | 0 | 0·6 | Foil intact, dull |
| 26 | 100 | 0·2 | 18·2 | 6 | 0 | 0·6 | Foil intact, dull |
| 31 | 100 | 0·2 | 18·2 | 3 | 198 | 0 | Foil intact, bright, brittle |
| 34 | 100 | 0·2 | 18·2 | 3 | 302 | 0 | Foil intact, dull, brittle |
| 36 | 100 | 0·2 | 18·2 | 3 | 198 | 0·4 | Foil intact, dull, very brittle |
| 38 | 100 | 0·2 | 18·2 | 3 | 198 | 0·5 | Foil intact, bright, brittle |
| 41 | 100 | 0·2 | 18·2 | 3 | 198 | 0·3 | Foil intact, dull, brittle |
| 51 | 40 | 0·45 | 41 | 3 | 150 | 0·2 | Foil intact, semi-bright, tough |
| 54 | 25 | 0·45 | 41 | 3 | 150 | 0·2 | Foil intact, bright, tough |

heated together in a closed system at 60°C. for 35 hr. Excess allyl bromide was extracted by ether using a Soxhlet extractor. The product was dissolved in water to yield a solution concentration such that 1 mL contained approximately 0·003 gm. of radioactive sodium allyl sulphonate. A radiochemical analysis of the final product showed a recovery of about 95 per cent of the original activity present in the sodium sulphite.

## Plating Procedure

The stock nickel solution was a Watts-type bath containing nickel sulphate, 300 gm/L; nickel chloride, 30 gm/L; boric acid, 30 gm/L, and a proprietary wetting agent, 5 mL/L. The *p*H was adjusted to 3·0. Plating was carried out in a small plastics cell in a glove box (Fig. 1). The anode used was electrolytic nickel, the current density range was from 10 to 55·5 amp/ft², and the plating times varied from 20 to 100 min. depending upon the thickness of deposit desired. Due to rapid changes of *p*H in the small volume of solution used, frequent additions of dilute sulphuric acid were made to maintain a *p*H range from 2·6 to 3·5.

Since a surface consisting of peaks and recesses was desired, grooved cathodes were prepared from brass blocks (Fig. 2). To obtain foils of the plated metal, it was necessary to provide a passivated surface. Therefore, the brass cathodes were first plated with a thin deposit of nickel from a sulphamate bath and then passivated by immersion for 1 min. in a 0·05 per cent potassium dichromate solution.

The organic addition agent was added to the nickel stock solution in the form of radioactive sodium allyl sulphonate (1 mL equals approximately 0·003 gm.). Additional non-radioactive sodium allyl sulphonate was added to bring the total concentration within a range of 1·5 to 2 gm/L. In some of the experiments, a second organic addition agent, N-allyl quinaldinium bromide, was added in amounts sufficient to produce concentrations from 2 to 6 mg/L. All of the additions and plating procedures were carried out under radiochemically safe conditions.

At the conclusion of plating, the cathode was withdrawn from the cell and rinsed with distilled water. Then, a scalpel was used to remove the foil from the cathode block. The foil was

*Fig. 2—The plastics cell A measured 2 in. long by 1 in. wide by 3 in. deep. The nickel anode is shown in place. The grooved brass cathode B measured 1·75 in. by 1·0 in. by 0·125 in. The grooves were 0·030 in. deep with an included angle of 90°. They were cut into one face of the cathode parallel to the long edge. There were 13 peaks and 12 recesses. Nickel foils C were deposited on the cathode and then removed for examination.*

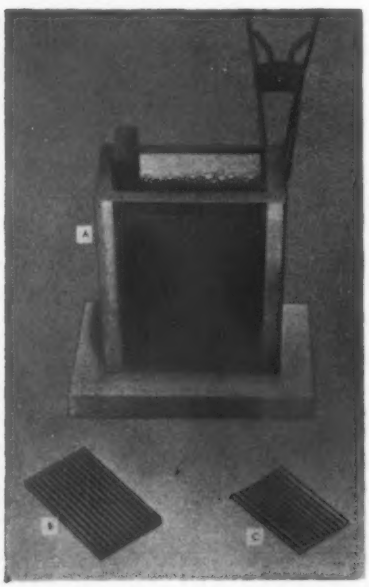

**TABLE II—LEAD SLIT COUNTING DATA**

**Top of Foil**

| Foil A | | Foil B | |
|---|---|---|---|
| Peak | Recess | Peak | Recess |
| 125 | 94 | 42 | 27 |
| 115 | 72 | 33 | 33 |
| 115 | 53 | 76 | 53 |
| 143 | 63 | 47 | 81 |
| 213 | 80 | 177 | 91 |
| 226 | 163 | 163 | 160 |
| 224 | 212 | 94 | 97 |
| 125 | 65 | 147 | 34 |
| 106 | 64 | 43 | 28 |
| 55 | 55 | 59 | 45 |
| 79 | 57 | 58 | |

**Bottom of Foil**

| Foil A | | Foil B | |
|---|---|---|---|
| Obverse of the Peak | Obverse of the Recess | Obverse of the Peak | Obverse of the Recess |
| 248 | 143 | 145 | 58 |
| 198 | 103 | 133 | 77 |
| 152 | 133 | 134 | 84 |
| 120 | 112 | 154 | 65 |
| 207 | 102 | 135 | 100 |
| 254 | 113 | 190 | 128 |
| 227 | 163 | 212 | 126 |
| 150 | 146 | 176 | 101 |
| 146 | 129 | 163 | 82 |
| 181 | 158 | 144 | 80 |
| 242 | 129 | 102 | |

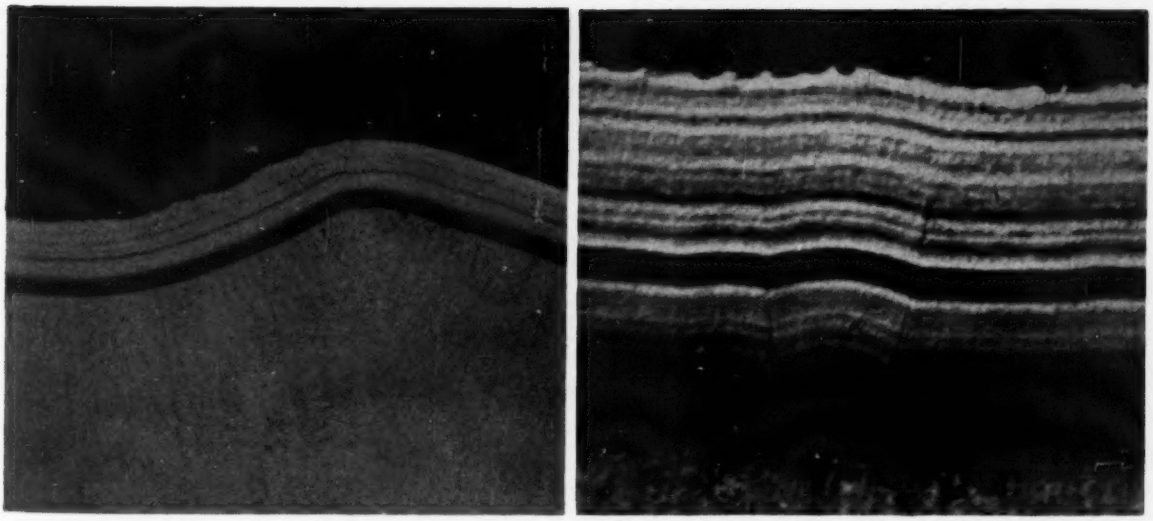

*Fig. 3—Photomicrographs of a section of a precision reference specimen of surface roughness plated from a solution containing only sodium allyl sulphonate are shown here. The specimen had a peak-to-valley height of 0·002 in. It was cross-sectioned and etched in 1 to 1 nitric acid-acetic acid. The specimen was then magnified 100 times (left) and 500 times (right), as shown in these photomicrographs*

scrubbed on both sides to remove any adhering material, rinsed with water and with alcohol, and dried under an infra red lamp to prepare it for counting and autoradiography. The data pertinent to the plating conditions and foils produced were recorded (Table I). The data were representative of the 65 plating experiments carried out and the 55 nickel foils produced.

To check whether or not these solutions and conditions produced levelling, portions of a Precision Reference Specimen of Surface Roughness[2] with two different degrees of surface irregularities were plated under conditions identical with those just described. Duplicate specimens were plated, one in a solution containing only sodium allyl sulphonate, the other in a solution containing both sodium allyl sulphonate and N-allyl quinaldinium bromide. These specimens were cross sectioned and examined microscopically (Fig. 3). Original and final roughness measurements were made with a topographic microscope and showed that levelling did occur. The solution containing both addition agents produced the greater degree of levelling.

*Fig. 4—Shown here is a nickel foil* A *on the sample pan* B *of a typical gas flow proportional counter. The advantage of such a counter, when counting low energy radioactivity such as S-35 emits, is its increased sensitivity which is achieved by placing the sample in the sensitive volume of the counting chamber, thereby eliminating the window such as is found in the Geiger tube. The corrugated lead foil* C *with its single slit was overlaid on the radioactive foil exposing a single peak (or valley by turning the foil over), and a count was made. Successive counts provided a profile of the areas in question. The lead foil was thick enough and big enough to screen out all of the radiation except that emanating from the area exposed by the slit.*

## Counting Procedures

Two methods were used to locate and define the areas on the plated cathodes and foils which contained the radioactivity. The first of these was a counting technique.

Since the energy of the beta particles emitted by S-35 atoms was very weak, the standard Geiger tubes were not sensitive enough. To achieve satisfactory sensitivity, a gas flow proportional counter was employed (Fig. 4). This procedure provided a gross count of the activity on the top and bottom of the foils, but gave no information relative to the distribution of the radioactivity across the face of the sample. It did, however, give data which were useful in computing autoradiographic exposure times.

Several innovations were tried to give more quantitatively useful data which might augment the results of autoradiography. One of these was a profile counting technique (Fig. 4). A 0·005 in. thick piece of lead foil was corrugated to duplicate the surface of the nickel foils by pressing the lead into the grooves of one of the cathodes. A single slit, 0·002 in. wide by 1 in. long was cut in the centre of one peak. This lead foil was then overlaid on the radioactive foil and a profile of the peaks and valleys made by successive counts on both sides of the foil (Table II).

*(To be concluded)*

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RUSSIAN WORK ON MECHANISM OF CORROSION UNDER STRAIN

# Corrosion in Magnesium Alloys

AMONG the known magnesium alloys, the highly elastic alloys of the manganese-aluminium-zinc-magnesium system show a strong tendency to corrosion under strain. Up to the present time, the mechanism of this corrosion disintegration is not fully understood, and the search has continued for radical methods of treating these alloys to prevent it, but they do not appear to have been successful.[1,2,3]

Recent Russian work on this corrosion mechanism[4] has, however, established the following points:—

(1) Aluminium is the main alloying component which is responsible for this corrosion tendency in the magnesium - aluminium - zinc - manganese system. This tendency to corrosion under atmospheric conditions appears only at aluminium concentrations which lead to the formation of supersaturated solid solutions, i.e. at concentrations of aluminium greater than 2-3 per cent. The strength of the alloy is increased by raising the aluminium content, but the resistance to corrosion under strain is reduced. Fig. 1 shows the influence of aluminium content on the corrosive disintegration of magnesium-aluminium alloys.

(2) The corrosion disintegration of magnesium alloys results from the selective dissolution of the supersaturated solid solution, or of the intermetallic compound $Mg_4Al_3$, with a resulting formation of microfissures.

From the above, it would appear that the alloy will fail to disintegrate only if it does not contain continuous chains of deposits of $Mg_4Al_3$ or the supersaturated solid solution to serve as zones of disintegration; a magnesium alloy must, therefore, possess a structure showing an aluminium-lean solid solution and uniformly distributed separate particles of the intermetallic compound. In order to obtain magnesium alloys of this structure, a method of thermal treatment is required which will lead to complete breakdown within the grains. This may be achieved during prolonged heating in the temperature range 175°-250°C.[5]; at lower temperatures, the breakdown of the supersaturated solution occurs very slowly.

The particular series of experiments which have been reported were carried out on a magnesium+8 per cent aluminium alloy, and from the phase diagram it is found that the solid solution contains 2·9 per cent aluminium at 175°C., 3 per cent at 185°C. and 3·8 per cent at 250°C. To obtain the required disintegration, the alloy was subject to thermal treatment at 185°C. for five days, followed by additional treatment at 60°-100°C. for some 15 to 30 days. The tension was applied to the specimens in a normal tensile testing machine with load values corresponding to values greater than 90 per cent of the 0·2 per cent proof stress, while the corrosive action was supplied by a 0·001 per cent NaCl solution in which the loaded specimens were immersed. The time taken for the first fissures to appear was measured in each case.

From an examination of the microstructure of the alloy, the following conclusions may be drawn. In the hot pressed condition, the alloy consists of a supersaturated solid solution of aluminium in magnesium with the intermetallic compound $Mg_4Al_3$ distributed along the grain boundaries. In the tempered condition, the alloy is "microscopically" uniform, supersaturated solid solution, with a considerable increase in grain size due to recrystallization during tempering. During a brief ageing of the tempered alloy, a partial breakdown of the supersaturated solid solution at the grain boundaries occurs, but without the preliminary tempering period the breakdown is not observed during heating for 30 days at 80°C. Breakdown within the grain is caused by ageing over 5 days at 185°C.

It is thus clear that an essentially complete breakdown of the supersaturated solution occurs during extended treatment at 185°C., and that after this period the alloy consists of the required solid solution, containing 3 per cent aluminium, and of individual particles of the intermetallic compound. The corrosion tests show that in the hot pressed, tempered condition (incomplete breakdown), the alloy under strain shows corrosion after only a short time. Prolonged heating at 185°C. prevents corrosion disintegration, and does not appear to impair the mechanical properties.

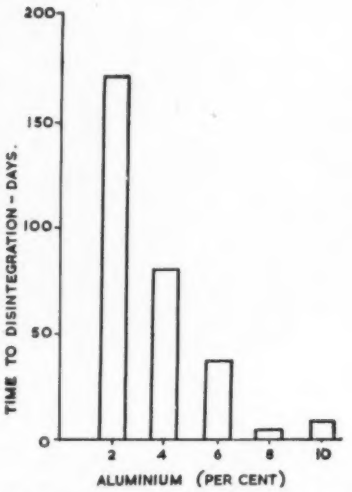


*Fig. 1—Influence of aluminium content on the corrosive disintegration of aluminium-magnesium alloys*

The solution of the practical problem of eliminating the tendency of magnesium alloys to corrosion lies in the determination of the minimum time of heating which would guarantee the complete breakdown of the solid solution at a given temperature; this is probably considerably less than the five days of the above experiments.

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# Standard Specifications

*Aluminium alloy sections for marine purposes* (*B.S.*2614:1959.) *Price* 12*s.* 6*d.*

REQUIREMENTS for two new series of aluminium alloy structural sections for marine use are included in this revised edition of B.S. 2614:1955. They relate to plain tee-bars for welding (from 1½ in. × 3 in. to 5½ in. × 8 in) and plain bulb plates for welding (from 3 in. to 8in.). The series specified in the 1955 edition—bulb angles for riveting, tee-bars for welding (with bead), bulb plates for welding (with bead)—have been retained in this edition.

A new dimension, an overall width for the bar, has been introduced into the tables for sections with bulbs; and the symbols for all dimensions have been amended so that they are in line as far as possible with those used in B.S.1161 "Aluminium and aluminium alloy sections."

The tolerance tables from B.S.1476, "Wrought aluminium and aluminium alloys—Plate," which were included in the earlier edition, have been replaced by special tables of tolerances applying to each series of sections.

Metric equivalents of all dimensions and tolerances have been calculated, and are included, for information, as separate tables.

Copies of the above-mentioned standard may be obtained from the British Standards Institution, 2 Park Street, London, W.1.

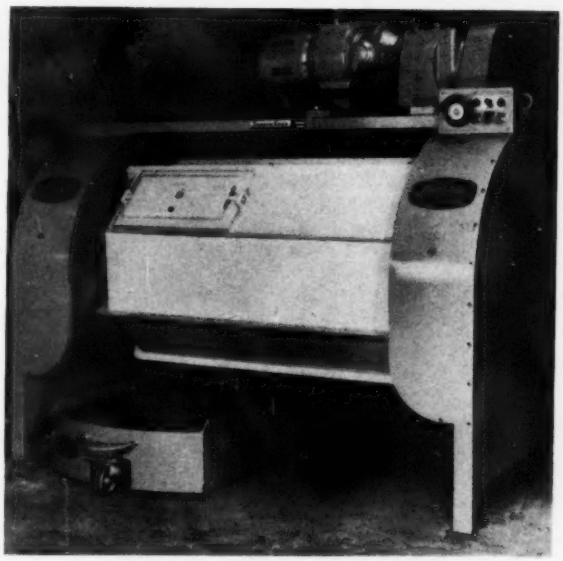
# Machining in Barrels

By D. J. FISHLOCK

(*Continued from* METAL INDUSTRY, 28 *August*, 1959)

MOST barrelling makes use of a horizontal octagonal-section barrel: barrels having more sides, i.e. tending towards a circular section, tend to carry the work round too far with the result that it is "thrown" instead of sliding; less sides, *per contra*, result in too little movement of the load. Barrels are normally lined with hard rubber or neoprene for protection and noise-reduction, although since the wear can be very heavy — especially on the ends — replaceable wooden liners have been advocated; maple, which is hard and resin-free, is suitable. Some units, e.g. Fig. 4, incorporate many ancillary features including quick-release loading doors, a safety valve to release internal gas pressures built up during long processing, speed control, automatic timers and reversing mechanisms, and safety screens. Much ancillary equipment such as loading and unloading aids, mechanical and magnetic separators, and storage and drying plant has been evolved to fully streamline barrelling operations.

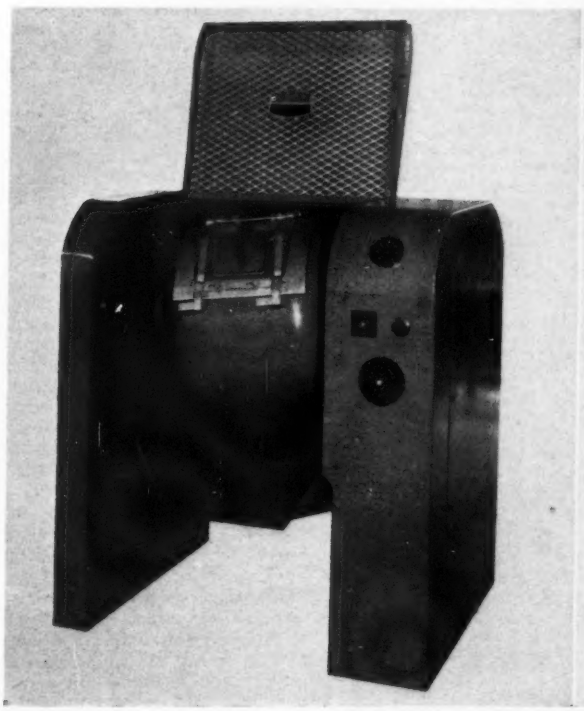
Mention has already been made of the relationship between barrel diameter and the speed of rotation, but most barrels can be varied in speed from about 4 to 30 or more r.p.m.; it is customary to employ the fastest speed possible commensurate with the components remaining unmarked by impingement. The standard range of barrel diameters extends from about 16 to 48 in., but barrels well outside this range are in use; the jewellery trade uses barrels of 8 in and less. Again, one manufacturer in this country is using an 18 ft. diameter barrel. There is still much use made of oblique tilting barrels, chiefly for the treatment of components too delicate to withstand the vigorous tumbling action of the horizontal fixed-speed unit; this design, however, appears to find little application in proprietary precision barrelling processes due to a tendency for the abrasive to separate from the mass and



*Right: Fig. 4—Large Almco-Supersheen barrel is 36 in. across flats, and 62 in. long, shown with guard up, displaying full opening doors and quick-acting cam bar locks*

*Below left: Fig. 5—Eccentrically-mounted Polymotion barrel (Fox Chemical-Engineering Works Ltd.) is claimed to allow free tumbling of many parts which would normally need to be fixtured*

*Below right: Fig. 6—Twin-barrel Polymotion machine. The circular barrels with dished ends cause less nicking of delicate work and prevent flat parts adhering to the walls*



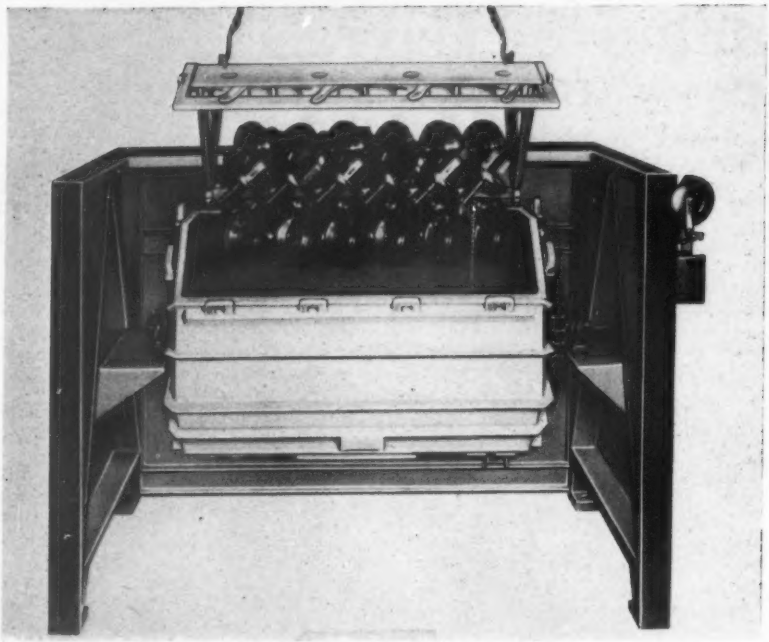
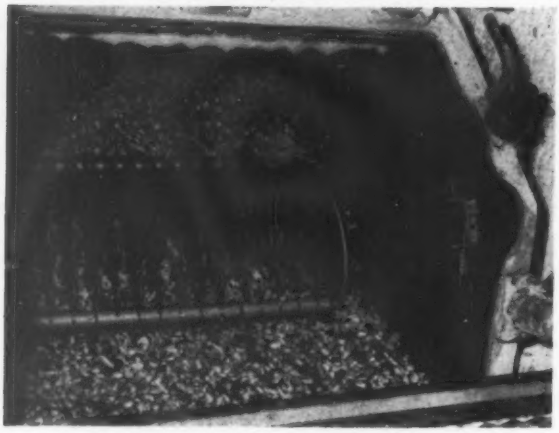


*Fig. 7—Fixture barrelling of a load of 24 milking machine components to remove burrs and improve surface finish, using a large Almco-Supersheen machine*



*Left: Fig. 8—Roto-Finish stationary fixture machine incorporating such features as a wide aperture door and slotted guide rail for rack. The guide rail is removable which allows the machine to be used for free barrelling*

*Below: Fig. 9—Four-door Almco-Supersheen fixture barrel, including two loading jigs. Components up to a few pounds in weight are secured to the door panels.*

move towards the rear of the barrel. The "bottle" barrel overcomes this to some extent, but variable speed horizontal barrels, with suitable control of the volume of media, solve most problems.

Modified horizontal designs which impart a secondary motion to the tumbling mass have tended to attract attention lately. Simplest of these is the inclusion of projections within the barrel; they certainly increase the tumbling action but decrease proportionally the standard of finish. Eccentrically-mounted barrels are believed to impart a "figure 8" pattern of movement within the mass along the length of the barrel, and it is claimed that this more rapidly and thoroughly mixes the various constituents of the tumbling mass, with an effective decrease in barrelling time. Illustrated in Figs 5 and 6 are examples of this type of machine, in which it is stated that many precision parts, heavy components and unusual shapes, which would otherwise need to be fixtured, can be freely tumbled. Some authorities, however, consider eccentrically-mounted barrels to be noisier, and the optimum loading to be only some 40 per cent capacity. The units illustrated have circular barrels which enables them to handle flat items which tend to adhere to a flat-sided barrel, while it is claimed that higher work loads are permissible, too. Another design, the triple action barrel, has polygonal sides as well as a polygonal section. The secondary motion here is from the centre of the mass towards each side, and it is understood to be especially effective for flat parts which adhere to the sides of a straight-ended barrel. It is interesting to note, in this connection, that a pure shaking action alone would not be satisfactory, since it would lead to stratification within the load due to the difference in density between the constituent materials.

Kellard[1] has also shown that the conception of fixture barrelling dates back about 60 years, but its modern application is quite recent and greatly extends the scope of barrelling. Several types of fixture are in general use, including unattached, stationary and power driven varieties. The unattached or "floating" fixture in its simplest form need be nothing more than a wire loop on which small light items are threaded; this prevents them adhering to the barrel walls and facilitates sorting. Usually the fixture takes the form of a simple jig which will keep the components apart during barrelling. This should be designed to minimize interference with the flow of media, but often there is some reduction of efficiency and processing times tend to be prolonged.

Stationary fixtures, dealt with in detail by Castle[3], are more generally used, and enable components of considerable size to be treated; components with one dimension exceeding 2 ft. and weighing over 112 lb. are by no means uncommon. The larger components are usually mounted on a removable

fixture which can be raised from the barrel by a hoist, but which is affixed to the barrel during processing, Fig. 7. Smaller components are loaded into jigs fixed into the barrel, Fig. 8. A third type of stationary fixture consists of a barrel of which two, four or all eight of the panels are removable. Relatively small components, up to a few pounds in weight, are then secured to the panels, Fig. 9. Fixture barrelling is generally applied to components exceeding 1 lb. in weight, but owing to the restricted number of components constituting a barrel load, processing times must be short if barrelling is to prove economical. It is also necessary to reverse the barrel half-way through every operation to ensure a uniform finish. Another modification involves the use of fixtures which are power-driven and can be rotated in the same or the opposite direction to the barrel; again chiefly applicable to quite large items it has been found that these can further reduce the processing time.

With fixture processing the location of the component in relation to the barrel rotation is very important; the fixture must be designed so that maximum action takes place where desired without shielding. The components must also be held firmly; should one component become loose during processing it will drift at random through the barrel compartment causing considerable damage to the entire fixture load. The cost of manufacturing such a fixture and the operational time required to load and unload can easily exceed the savings obtained by barrelling. For this reason many companies are now considering the use of multi-compartment barrels. Fig. 10, for treating large parts individually. This method has an advantage in that the components can be removed from the compartment without discharging the media and compound, thus showing further savings in material, operator's time, and fixtures.

Submerged barrelling, well known as tubbing in the jewellery trade, though only recently introduced into this country as a precision process, is probably the brightest prospect of current barrelling developments. The importance of removing detritus from the surface of work and chip during, especially, operations designed to achieve a very high surface finish is now generally appreciated. This is aided by periodically flushing out the mass, by cleaning the work prior to barrelling, and by the addition of dispersing agents to the compounds. One manufacturer also claims interesting results from the use of a pelton-wheel attachment to the barrel which scoops up water as it rotates and shoots it in spurts into the tumbling mass. Submerged tumbling, however, overcomes the problem by using a perforated horizontal barrel which rotates in a tank of the compound.[4] Detritus is thus continually flushed from the mass into the tank. The design of the apparatus naturally precludes the use of abrasive-loaded compounds, but this obstacle is overcome by the use of the new synthetic chips; again compounds which comprise little more than industrial detergent powders often prove adequate. Savings of 80 per cent and higher are claimed on compound costs alone, while the surface finishes obtainable are unmatched by any other barrelling technique.

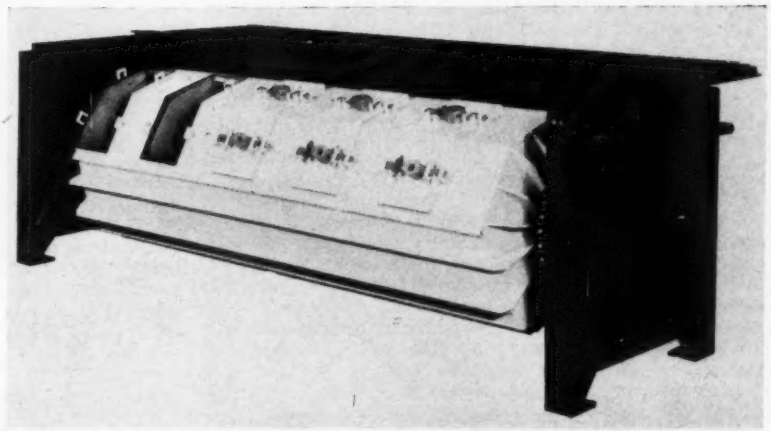


*Fig. 10—Multi-component Almco-Supersheen unit wherein large components can be individually processed without risk of being damaged by coming into contact with other heavy parts*

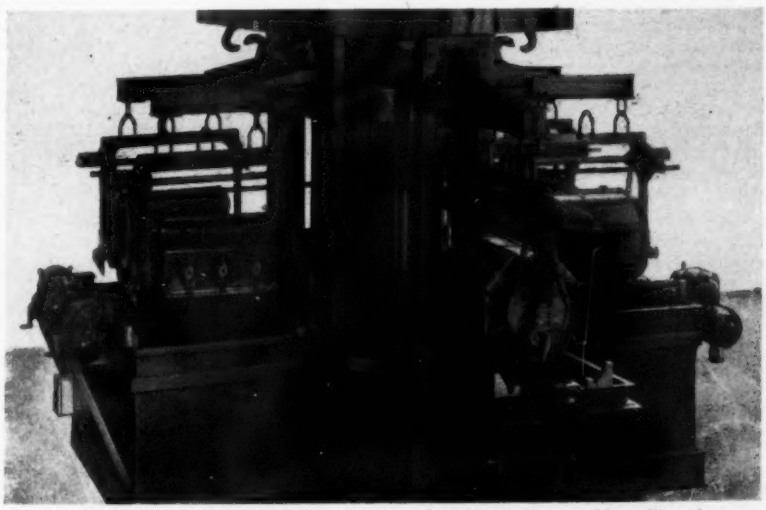


*Fig. 11—Closed-loop Sub-O-Matic skip station Almco-Supersheen submerged barrelling plant can be built up from individual tanks. The centre section is added when six or more tanks have been installed*

Of greater moment, though, is the extent to which submerged barrelling can be automated and integrated into flow-production lines. By arranging a line of standard units on the in-line, or closed-loop systems, with an overhead conveyor, the barrels can be transferred semi- or fully-automatically through the various stages and swills; indeed, such a system could be linked to an electroplating line. Such a line could, therefore, be started with one or two barrels, the number being increased as experience is gained. When six or more tanks are installed a centre section can be added to make the line automatic, Fig. 11.

The possibility of using more concentrated and active solutions which exert a chemical polishing action is also opened up; Marshall's solution for brightening ferrous metals and a variety of solutions for polishing aluminium are examples. Machines of this type are currently in production use in the U.S.A. and have recently become available here.

A British development of submerged barrelling, at present only in the design stage, promises further major space reductions. This involves a series of barrels with internal spiral conveyors through the length of which the tumbling mass slowly but continuously passes. Each discharges into another, similar, barrel thus entirely eliminating the need for separate transfer gear and the inevitable transfer delays.

**References**

[3] C. H. Castle; *Electroplating Engineering Handbook*, Graham, Reinhold, 1955.

[4] Anon; *Automobile Engineer*, 1957, October.

*(To be concluded)*

# Products and Processes

TRENDS IN THE DEVELOPMENT, APPLICATION, PROCESSING, DESIGN AND WORKING OF NON-FERROUS METALS AND THEIR PRODUCTS

## Long Extruded Copper Bars

NIMROD, the 7,000 million electron-volt proton synchrotron, which will be used in studies of nuclear and sub-nuclear phenomena, is being built at the Rutherford High Energy Laboratory of the National Institute for Research in Nuclear Science, situated just outside the Atomic Energy Research Establishment, Harwell. It has involved James Booth and Co., Birmingham, suppliers of the copper rectangular conductor bars required for the magnet core windings, in a number of problems.

The bars are $2\frac{3}{8}$ in. by $1\frac{1}{8}$ in. in cross-section and have a central hole $\frac{3}{8}$ in. by $\frac{3}{8}$ in. through which demineralized water will be pumped for cooling purposes. Some of the bars are over 57 ft., the longest copper section of this size yet produced.

Extrusion, which is carried out on a large hydraulic press, presented the first technological problem. Since close dimensional tolerances are required, the bars, after pickling, are cold drawn in several stages to the final dimensions and shape. At the fabrication stage the bars will have to be bent, and a bright annealing furnace is used to produce the dead soft condition required. The dimensional accuracy of the central hole is tested by blowing a ball bearing of the appropriate size through its entire length.

The bars weigh about 8 cwt. each and, in view of their soft condition and the fact that they have to be dead straight, they require frequent support along their length when being lifted from point to point at various stages of manufacture. Specially designed beams were constructed for this purpose and, in lifting, two overhead travelling cranes are employed so as to give support to the load in all positions. Moving the bars from shop to shop was even more of a problem. None of the normal trucks used by James Booth was long enough to take the bars, and a truck 60 ft. long was constructed on the premises. Even so, the difficulty of negotiating the truck with its load around a number of bends had to be overcome, and in some cases it could only be done by structural modifications to some of the shops.

The first batch is due to leave the works this week. Finding suitable transport was a further problem because it was essential that the bars should lie flat along their entire length and reach their destination in this condition. After many vain enquiries a contractor was found who could undertake the job, and the bars will be taken in a specially constructed vehicle by a selected route to Manchester where they will be fabricated into the finished coils by Metropolitan-Vickers Electrical Co.

## Fettling Die-Castings

THOUGH primarily designed as general handyman tools, Stanley shapers are increasingly being put to industrial uses. It has, indeed, been found that they can speed up, and often cut the costs of, trimming and filing operations.

A recent example comes from the Wolverhampton Die Casting Co. Ltd., which produces large quantities of pressure die-castings each week.

Shapers were adopted for fettling certain aluminium castings before they left the factory, and it was discovered that one replaceable shaper blade would outlast by six or eight times the bastard files previously in use. One blade was in constant daily use for eight months before needing replacement.

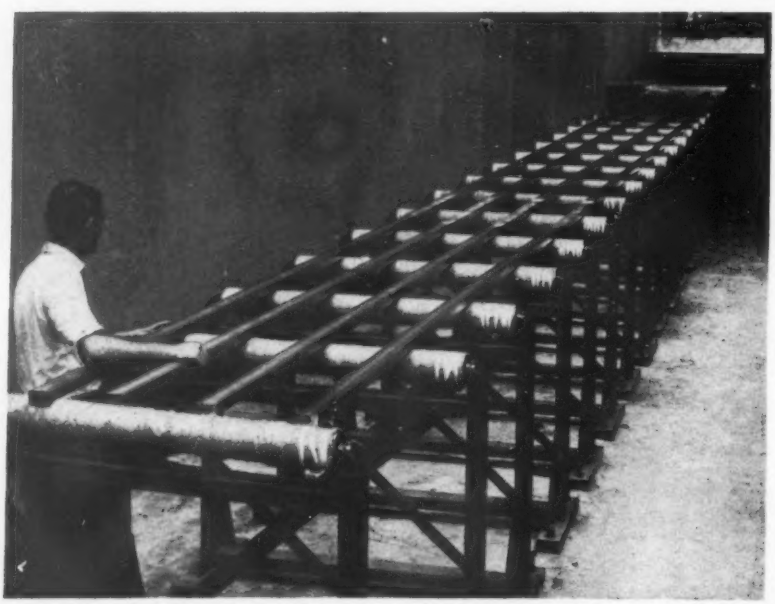
## Mass Spectrometry

A FIRST production model of the MS7 Mass Spectrometer has just been completed by Metropolitan-Vickers Electrical Co. Ltd. The instruments now being produced are for the National Physical Laboratory, the Services Electronics Research Laboratory, the Mond Nickel Company and the U.K.A.E.A.

This mass spectrometer has been designed specifically for the purpose of measuring minute impurities in solid substances using the spark ionization technique, having particular advantages where it is essential to use materials of the highest purity, such as nuclear engineering, semi-conductor research and manufacture, and in the development of non-ferrous metals and alloys.

Some of the materials which have been successfully analysed down to 0·01 p.p.m. with the prototype model include uranium, reactor grade graphite, germanium, selenium, silicon, gallium-arsenide, magnesium, titanium, tungsten, iron, copper, aluminium, tin, and nickel-chromium alloys.

The spectrometer is a double focusing instrument of the Mattauch type, in which positive ions, representative of the sample composition, are produced when a high-voltage spark occurs between two electrodes of the



*Extruded copper bars about to enter the annealing furnace. Because of the unusually long lengths called for, and the demand for straightness in the delivered bar, special measures for support, handling and transport had to be introduced at all stages of manufacture*

*Using a Stanley shaper-file at the Wolverhampton Die Casting Co., Ltd., to fettle an aluminium casting which will eventually be part of an electric washing machine. One shaper blade was found to outlast by six or eight times the conventional files previously used for fettling*

sample material placed close together in vacuum. After passing first through an electrostatic analyser, and then through a magnetic analyser, the ions come to focus according to their mass, but irrespective of their initial energy, as a series of lines on a photographic plate.

For the analysis of impurities in solids the photographic plate is used as an integrating device, and a series of exposures of gradually increasing length are taken (a rack mechanism allows up to 10 exposures to be recorded on the same plate and the exposure is accurately determined by the total integrated charge falling on the monitor collector). The concentration of the impurity is estimated from the intensity of the lines on the longer exposures, and with this technique concentrations down to the level of 0·01 p.p.m. can be estimated.

The method is particularly useful for giving a general picture of the impurities in a solid. The whole mass range from 7-240, covering all elements, can be recorded in a single exposure of the photographic plate. Compared with emission spectroscopy, the spectra are simpler and the elements easier to identify. Moreover, qualitative and semi-quantitative analyses can be carried out without extensive calibration.

*The Metropolitan-Vickers MS37 Mass Spectrometer, designed for the detection of impurities in materials of the highest purity, by means of the spark ionization technique*

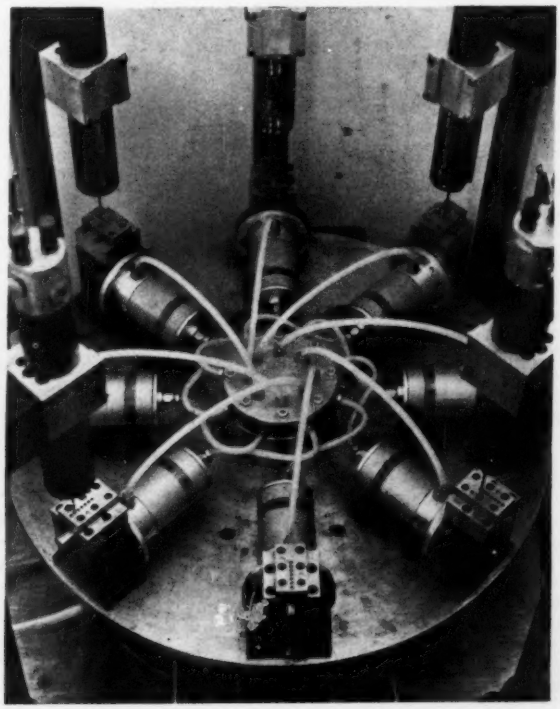
## Low Cost Automation

A MULTI-STATION rotary transfer machine which will be shown working at the European Machine Tool Exhibition in Paris this month, drills automatically to fine tolerances seven holes $\frac{1}{4}$ in. in dia., at $\frac{3}{16}$ in. centre distance, in a small brass component, the production rate being $7\frac{1}{2}$ sec.

Designed and manufactured by Centec Machine Tools Ltd., of Hemel Hempstead, the basic unit is a 16 in. dia. Centec rotary indexing table which can be set to index any angle divisible by 3 up to 180°. It has an accuracy of repetition of any position ±1·5 sec. and an angular accuracy of ±5 sec. of a degree. Its speed of operation is controlled by a variable orifice of a hydraulic dashpot and by pneumatic flow restriction. A specially designed rotary valve sequences the release and clamping of the components at the pneumatic fixtures.

Air-operated cylinders and valves manufactured by Maxam Power Ltd., Camborne, Cornwall, are incorporated to control and operate the sequencing and clamping systems. The machine is equipped with standard Par-A-matic power units, pillar supported, for drilling.

*Arrangement of the drilling, feed and ejecting positions on the indexing table of the Centec multi-station rotary transfer machine, and the layout of the Maxam 2¼ in. clamping cylinders and Par-A-matic power units*



LITTLE KNOWN COLLABORATOR IN WORK ON NICKEL CARBONYL

# Pioneer in Nickel Development

IN the discovery of the Mond nickel process as given in textbooks, little or no acknowledgment is made to a collaborator of Ludwig Mond, namely Carl Langer, who was born 100 years ago. In the historic work on nickel carbonyl and its application to nickel extraction, Langer, in association with Ludwig and Robert Mond and with a fourth research worker, Frederick Quincke, played a prominent part, so that his centenary is of interest to metallurgists.

Round about 1885 Ludwig Mond took on as assistant this young Austrian who had been student and then research assistant to Victor Meyer of Zurich. Langer had proved a first-rate chemist in work on the dissociation of gases and on amines and azo-dyes, especially when working at the B.A.S.F. in Germany. He seemed, therefore, a likely choice to help Mond in work on alkali manufacture, when in 1888 the Brunner Mond company had begun crystal soda production and the manufacture of a refined bicarbonate of soda. Langer settled in England and took up duties at Mond's research laboratory in Avenue Road, St. John's Wood, studying such problems as cheap electricity and improvements in the ammonia-soda process. By the autumn of 1888 two problems arising from Mond's wide interests were concerned with carbon monoxide and nickel; hence the whim of fortune that the reaction between these two should be stumbled upon as a result. The first of these was a search for the gas battery, "the dream of the electrochemist," a study in which Mond sought to replace hydrogen in the battery by producer gas. Since carbon monoxide and hydrocarbons in producer gas ruined the absorptive power of electrodes coated with platinum black, the gas was passed over finely-divided nickel at 40°C. to form carbon and carbon dioxide. Nickel also came into the story when nickel valves in Mond's bleaching powder production (from the ammonium chloride in the ammonia-soda process) soon deteriorated, this deterioration being due to inert gases containing oxides of carbon which were used to remove ammonia from the pipelines. So with such problems under investigation at Avenue Road, the idea of studying effects of carbon monoxide on nickel at various temperatures brought the discovery which proved to be one way to separate nickel from copper.

It was in October 1889 that Langer was waiting for the flame of tail gases burned in a laboratory burner to die down before ceasing work for the day. But round about 150°C. Langer noted the flame becoming more luminous until the temperature of the gases fell below 100°C. Arsenic was one "impurity" suspected to be the cause, since the carbon monoxide was prepared from a formate-sulphuric acid reaction. Yet a deposit formed on a porcelain test-plate was bright nickel in place of dull arsenic, suggesting that a volatile nickel compound had been formed and decomposed. It seemed a peculiar suggestion in the light of those days; but nickel carbonyl was discovered as a result, and the Mond nickel process came after three years' work, mostly at Henry Wiggin's premises at Smethwick. Nickel history is enlivened with a number of such "accidental discoveries" as they are called. An early one came when Salter, of the Canadian government survey, noticed his compass-needle deflected 12° from normal; and although a geologist found nickel deposits to be the reason, the matter was not taken further. Thomas Flanagan, working the C.P.R. cutting, noted gossan rock in which copper sulphide was found, yet only in 1888 was Canadian copper smelted near the site. Then came the rival extraction to the Mond process when Colonel Thompson, of the Orford Copper Company, studied the difficult question of separating copper from nickel. A pot of metal on a dump was discovered to have separated into two layers, the "metal" having been produced by charging matte into a reverberatory furnace with sodium sulphate and carbon. The upper layer thus contained copper and iron in the molten sodium sulphide formed by reduction, and the lower layer nickel sulphide in the sodium sulphide. Since Henry Wiggin in 1896 contacted Thompson, expressing interest in the Orford process, he had a link with both nickel extraction processes.

To round off the tribute to Carl Langer, mention must be made of his great achievement at Clydach, Swansea, where 60 years ago the famous refinery was built. Langer, from the first, had shown himself to be an efficient manager and administrator, this not only at Clydach, but also in association with a mining engineer, Mohr, when looking for Canadian ores for exploitation. Langer selected the Clydach site, lived on the spot, and supervised the building. He became manager and director until ill health caused him to retire to Switzerland.

# Nickel-Chromium Casting Alloy

NIMOCAST 713C, recently introduced in this country by Henry Wiggin and Company, Ltd., is one of a number of complex high-nickel casting alloys developed in recent years for high-temperature turbine blading. It combines outstanding strength with excellent resistance to thermal fatigue at temperatures up to 980°C. and is, therefore, of interest as a possible alternative to wrought alloys, which offer difficult production problems when developed for service at such elevated temperatures. In the U.S.A., where cast rotor blades are considered acceptable for production engines and are, in fact, used in substantial numbers, this alloy is now well-established and has won a reputation for reliability under arduous service conditions.

Nimocast 713C is readily castable and develops its best properties when cast in vacuum. Alternatively, it can be cast under a protective atmosphere, such as argon. A heat-treatment of two hours at 1.170°C. followed by air cooling is beneficial but not essential, unless the maximum mechanical properties are required.

**STRESS-TO-RUPTURE PROPERTIES**

| **Investment Cast in Argon** | | **'As Cast' Condition (no Heat-Treatment)** | | |
|---|---|---|---|---|
| **Temp.** | **30-hr. Life** | **100-hr. Life** | **300-hr. Life** | **1,000-hr. Life** |
| 815°C. | 28·0 | 24·5 | 21·5 | 18·0 |
| 870°C. | 19·5 | 16·5 | 14·5 | 11·5 |
| 940°C. | (12·5) | (10·5) | (8·5) | — |
| 980°C. | 8·5 | 7·2 | — | — |

| **Investment Cast in Vacuum** | | **'As Cast' Condition (no Heat-Treatment)** | | |
|---|---|---|---|---|
| **Temp.** | **30-hr. Life** | **100-hr. Life** | **300-hr. Life** | **1,000-hr. Life** |
| 870°C. | 22·8 | 19·0 | 16·5 | 14·5 |
| 940°C. | 14·0 | 12·0 | 10·0 | 8·5 |
| 980°C. | 10·5 | 8·7 | 7·5 | 6·8 |

(*Figures in brackets are extrapolated values*)

# Industrial News *Home and Overseas*

**Expansion Plans**

Incorporated in 1930, **British Titan Products Co. Ltd.** celebrated in July last the 25th anniversary of the company's first production of titanium dioxide. Presenting a wallet to each employee of the company on this occasion, Mr. G. H. Beeby, British Titan's chairman, said that production in their first year had been 2,000 tons of pigment; in 1959 it would be nearly 90,000 tons in their English factories alone.

To meet the increasing demands for Tioxide in the United Kingdom and overseas, B.T.P. is undertaking a big expansion programme. Plans have been approved for extensions and entirely new plants estimated to cost in total some £14 million.

The new development plan will extend the capacity of the Grimsby plant to 85,000 tons p.a. It will include a comprehensive modernization scheme to give greater flexibility to the whole plant and to allow for quality improvements and perhaps the manufacture of additional grades of pigments. The total capacity of the United Kingdom plants at Grimsby and Billingham will then amount to some 105,000 tons p.a.

The Australian Titan Products plant at Burnie, Tasmania, has been continuously expanded since it was opened in 1949, and the output is to be raised from 8,000 to 10,000 tons p.a. by the end of 1959. Early in 1962 the capacity will have been increased to 16,000 tons p.a. Still further extensions will increase this to 22,000 tons p.a. by about the end of 1964.

In India, the company holds interests in Travancore Titanium Products, whose production will be stepped up from 1,800 to 3,600 tons/year by 1961. In South Africa, a plant is being established in association with African Explosives and Chemical Industries Ltd., to be completed in 1961, with an output of 10,000 tons/year.

In Canada, B.T.P. is to establish a company and erect a plant there at a cost of some £6 million. It is planned to have an initial capacity of 20,000 tons p.a.; both Rutile and Anatase will be produced and the plant is being designed to allow for big future extensions.

**Export Business**

Entitled "A Simple Guide to Prospective Exporters," a booklet has been produced by **The Gauge and Tool Makers' Association,** Standbrook House, 2-5 Old Bond Street, London, W.1, with the particular object of assisting firms wishing to enter the field of overseas trading for the first time.

The subjects dealt with in the booklet include representation in foreign markets, how to appoint an agent, methods of exporting, methods of payment, etc., and copies are available at 3s. 6d. each, post free, on application to the Offices of the Association.

**Non-Ferrous Club**

Instead of its usual monthly luncheon meeting, the **Non-Ferrous Club** has arranged for a dinner to be held at Chadwick Manor, Knowle, on Wednesday, September 9, at 7.15 p.m. for 8 p.m.

As this is a special occasion, it has been decided to invite ladies, together with any number of guests members may care to bring. The dinner will be followed by a cabaret, in which Miss Ann Shelton will appear, and the evening will be rounded off by dancing to David Rose and his Band. Tickets, price 35s., may be obtained from M. L. B. Wright at 36 Sheepcote Street, Birmingham, 15. Dinner jackets will be worn.

**New Address**

From Monday, September 14, the address of **Philipp and Lion,** suppliers of metals and minerals, will be Chile House, 20 Ropemaker Street, London, E.C.2. The firm's telephone number and telegraphic address will, however, remain unchanged.

**Bronze and Brass Founders**

A meeting of the Lancashire and Cheshire area members of **The Association of Bronze and Brass Founders** will be held on Tuesday, September 22, 1959, at the Engineers' Club, Albert Square, Manchester, commencing with tea at 5.30 p.m., when current Association business and any other matters which members generally wish to raise will be dealt with.

Following the members' meeting, there will be an open meeting at 6.30 p.m., when Mr. W. H. Davies will repeat his talk on "Costing a Casting."

**Trade with Latin America**

On his return from investigating possibilities for refractory equipment in Latin America, Mr. W. T. Hale, of **Thomas Marshall and Co. (Loxley) Limited,** made the point that, while there is an enormous potential for development, and foreign capital is badly needed, British credit terms are not sufficiently flexible to compete with those offered by Japan and Germany.

In the Argentine last year, Marshalls supplied £45,000 worth of equipment, and orders are being received for further supplies. A market exists for British refractory equipment only until such time as local production has expanded sufficiently to meet local requirements. In Brazil, where Thomas Marshall received an enquiry to the value of £11,000 from Petrobras, the refractories industry is well established, and such imports as are encouraged are of a very specialized nature. In Chile, there seems to be a welcome for new capital investment, as elsewhere in Latin America.

**Metal Merchants' Golf Meeting**

Final details of the arrangements for the Autumn Meeting of the **National Association of Non-Ferrous Scrap Metal Merchants Golfing Society** are as follows:

A dinner will be held at the Midland Hotel, Birmingham, on Tuesday, September 22, at 6.45 p.m. for 7.30 p.m. It is hoped that all members, playing and non-playing, will attend.

The golf meeting will take place on the following day, September 23, at the Edgbaston Golf Club, Birmingham, play starting at 9.15 a.m. sharp. Two rounds will be played. In the morning a medal round for the Captain's Cup, in which the Veterans will also be competing for the Ellis-Masur Cup. In the afternoon, a greensome (playing the selected drive of each couple) against bogey.

Players should make their own arrangements for partners in the morning round. Lists of members may be obtained from Mr. G. B. Garnham, Plantation House, Mincing Lane, London, E.C.3.

**New "600" Company**

A new company, **George Cohen (Dublin) Limited,** has been formed to undertake general machinery trading in the Republic of Eire. At the depot of the new company, Georges Place, Blackrock, Dublin, a contractors' plant hire fleet is available, including such diverse items as cranes, compressors and welding sets. The depot also holds stocks of machine tools for sale.

The general manager of the new company is Mr. E. P. Purcell, A.M.I.C.E., and the board consists of Mr. Philip B. Levy, Mr. Felix L. Levy, Mr. D. W. Cooper and Mr. C. Drury.

**Nimonics on Show**

At the S.B.A.C. Exhibition at Farnborough, the theme of the stand (No. 17) of **Henry Wiggin and Company Limited** is the progress made in the development of the Nimonic series of nickel-chromium alloys and the introduction of improved manufacturing techniques. These developments enable higher operating temperatures in gas turbine engines and are of considerable interest to the aircraft industry.

In addition to the Nimonic series of alloys, other nickel-containing materials produced by the company are featured, including the newly-introduced Nimocast nickel-chromium casting alloys.

**Works Combined**

For the past three years, the **Bromsgrove Die and Tool Co. Ltd.** has operated a works at Suckley, Worcestershire, in addition to its plant at West Bromwich. The two works have now been co-ordinated, and in future all business will be carried out at Grove Hill, Suckley. The majority of the plant from West Bromwich has been transferred. The company's new telephone number is Suckley 300.

**Mond Nickel at Farnborough**

Featuring the importance of its products to British industry, the **Mond Nickel Company's** stand, No. 171, at this year's S.B.A.C. exhibition will contain a full range of technical publications dealing with the use of nickel-containing materials in modern industry, with particular reference to the aeronautical field.

Members of the company's Development and Research Department will be available to answer technical enquiries and discuss the latest developments in the uses of nickel alloys in industry.

**Anti-Corrosion Treatments**

On its stand (No. 83) at the S.B.A.C. Flying Display and Exhibition at Farnborough next week, **The Pyrene Company Limited** is exhibiting a wide range of specialized fire protection equipment for aircraft and airfields, ranging from small hand-operated extinguishers to built-in

aircraft installations and aircraft crash tenders.

Also on Stand No. 83 can be seen illustrations of the processes employed by The Pyrene Company's Metal Finishing Division, including "Pyluminizing" and "Bonderizing" for the bonding of paint to aluminium and other metals. In addition, there are illustrations of the effective anti-corrosion defence imparted by a "Parkerized" and "Endurion" treated steel surface. The Pyrene Company plays a leading part in the pretreatment of metal components used in the aircraft and guided missile industries.

### Welding Electrodes

Reductions in the price of their arc welding electrodes have been announced by **Quasi-Arc Limited,** of Bilston, Staffs.

The new price reductions will apply to all deliveries of mild steel electrodes made on and after Thursday, October 1 1959.

### Fifty Up!

With the recent order for two 5,000 ft³/hr. nitrogen plants, the Gas Atmospheres Division of **The Incandescent Heat Co.** has now installed or has on order fifty nitrogen plants with capacities ranging from 500 to 32,000 ft³/hr. The majority of these plants are packaged units and can be transported in one piece.

Production of packaged nitrogen generators, inert gas plants and furnace atmosphere generators is a small part of the work of the Gas Atmospheres Division, who also engineer and produce gas processing equipment and complete plants for the production of hydrogen, carbon dioxide, and synthesis gas.

### Temperature Control Courses

The saturable core reactor forms the basis of the stepless temperature controller, an instrument superior to both the on/off and time cycling proportioning controllers. At the present rate of improvement of extrusion and moulding techniques, and the development of new materials, accurate and reliable temperature control is becoming increasingly important in the plastics industry, and there is a growing tendency towards stepless control.

These controllers are also used extensively in furnace operation, where a high degree of accuracy of temperature control is necessary.

Courses of instruction of one day's duration on the saturable core reactor are to be organized by **West Instrument Ltd.** The first of these is to be held on October 14 and 15 at the company's London office.

The lectures will be informal, and a proportion of the time will be devoted to discussion and the answering of questions. The talks will be given by Mr. E. L. Clarke, Mr. L. M. Collyer and Mr. W. Proudfoot.

A brief summary of the theoretical background of the saturable core reactor will be given to those attending the course.

Executives who are interested are invited to write to Mr. James Hartnett, West Instrument Ltd., 52 Regent Street, Brighton 1, Sussex.

### Film Festival

An International Film Festival is to be held in Oxford from September 23 to October 2, 1959. It is the 13th Congress of the International Scientific Film Association, at which representatives of documentary and scientific film organizations from 25 countries will be taking part.

During the 10-day Congress the delegates will see more than 100 films from overseas dealing with a wide range of scientific subjects. A number of films made in Great Britain will be shown, but their number will have to be limited as it is a tradition of the Congress for the films from overseas to have the priority showing.

The rapid growth of the International Scientific Film Association, which was founded in 1947, reflects the increasing importance of the work. It now has a membership of 30 nations, many of them being the Eastern European lands—also Japan.

### Metal Finishing

In collaboration with the Education Committee of the Institute of Metal Finishing, a course of six lectures has been arranged by **Borough Polytechnic,** Borough Road, London, S.E.1, on "Plating Shop Management and Control." They will be given on Tuesday evenings, commencing October 6, 1959, at 7 p.m. Lecturers will be Mr. E. A. Ollard, A.R.C.S., F.R.I.C., F.I.M., who will deliver five of the lectures, and Mr. H. R. King, manager of the Plating and Radiator Division of Vauxhall Motors Ltd. Applications for admission to the course should be addressed to the Secretary, Frank J. Packer, F.C.I.S., A.M.B.I.M., with the fee of ten shillings.

### Rustproofing Process

By arrangement with B.B. Chemical Co. Ltd., the Metal Finishing Division of **The Pyrene Company Limited** is now marketing the "Endurion" process as an addition to their established range of "Parkerizing" rustproofing finishes for the treatment of ferrous metals.

The Endurion process is a simple immersion treatment used in conjunction with Parkerizing zinc phosphate systems. The coating produced, which is light grey in colour, can be waxed, oiled or painted. Optionally, the natural grey coating can be coloured by dyeing, followed by waxing, oiling or lacquering.

### Order for Tube Polishing Equipment

An order from V/O Stankoimport, Moscow, U.S.S.R., for two double internal tube polishing machines complete with dust extraction equipment and necessary ancillary equipment has been received by the Tube Investments subsidiary company, **Brookes (Oldbury) Ltd.** The value of the orders is over £30,000.

The machines are for the internal polishing to mirror finish of stainless steel tubes as used in the dairy, brewing and food industries. They polish two tubes simultaneously up to 40 ft. in length.

### Close Down

Following upon the recent amalgamation with Associated Lead Manufacturers Ltd., **St. Helens Smelting Company Ltd.** is no longer continuing in business and its office will be closing shortly.

### Exhibition of Welding Equipment

At an exhibition at the Rutherford College of Technology, Newcastle upon Tyne, this week, the Heating and Welding Department of the **A.E.I. Transformer Division** has been showing a wide range of its welding equipment. The exhibits included spot and projection welding apparatus, flash butt welders and rivet heaters, as well as various types of arc welders and electrodes.

### Malayan Tin

Malayan tin production in July totalled 71,305 piculs of tin concentrates, containing 5,215 tons of tin metal based on an assay value of 75.71 per cent, according to figures issued at Kuala Lumpur. June output amounted to 2,909 tons of tin metal.

At the end of July there were 40 dredges, 342 gravel-pump mines and 47 other tin mines in operation, making a total of 429 active tin mines. The end-June figures were 39 dredges, 325 gravel-pump mines and 46 others, making a total of 408 active tin mines.

### Canadian-Japanese Nickel Contract

A three-year contract has been signed by Giant Nickel Mines Limited with a Japanese firm for the sale of all nickel concentrates from its mine near Hope, 100 miles east of Vancouver, Canada. The first shipment to Sumitomo Metal Mining Company Ltd. was expected to leave Vancouver in February next year. The Giant Nickel Co. expects to complete its present concentrate contract with the Sherritt-Gordon Refinery at Fort Saskatchewan, Alberta, next January. The Japanese firm will pay a "somewhat higher" price than Sherritt-Gordon, and freight expenses will be considerably reduced.

### Current Control

A range of mercury-pool ignitron tubes for the control and rectification of heavy alternating currents has been introduced by **Mullard Ltd.,** Mullard House, Torrington Place, London, W.C.1

Four of the tubes are intended primarily for welding control circuits, furnace control and similar applications, while the fifth is designed specifically for power rectification, and has limited applications in A.C. control.

The Types 5551A and 5553B tubes are intended primarily for use in single- or three-phase welding control circuits. In single-phase circuits, the maximum demand rating for two tubes connected in inverse parallel is 600 kVA for the 5551A and 2,400 kVA for the 5553B. Both tubes can be fitted with a thermostat to give control of the water flow or protection against overheating.

The 5552A is intended for use in single-phase welding control circuits. Two tubes in inverse parallel have maximum demand rating of 1,200 kVA. Provision is made for fitting a thermostat.

The Type 5822A tube is designed especially for operation under the severe conditions encountered in three-phase frequency changer circuits for welding and furnace control. In this application, six 5822As can control up to 860 kVA for resistance welding and 240 kW for furnace control. Provision is made for fitting a thermostat.

### Magnesium Plant Closing

The magnesium-producing facilities of the Aluminum Company of Canada Limited are to be suspended indefinitely.

The magnesium plant which has operated as a minor division of Alcan's aluminium smelting facilities at Arvida, Quebec, has an annual capacity of 4,000 tons of magnesium ingot. In recent years the plant has operated at rates substantially below capacity, producing mag-

nesium mainly for export to world markets.

In future, Magnesium Company of Canada Ltd. (Magcan), an associated company engaged in the sale of magnesium in Canada and overseas, will obtain its magnesium requirements through agreements made in Canada and the United States.

Under the U.S. arrangements, Magcan will obtain a portion of its magnesium requirements from the Dow Chemical Company, delivering to them a pro rata tonnage of Alcan's aluminium ingot in exchange.

**Flexible Shaft Machining**

Developed specifically to meet the requirements of the skilled craftsmen engaged on high precision work, a new flexible shaft machine has been introduced by **B. O. Morris Ltd.,** of Coventry.

This machine, the Morrisflex 300, is a simple, powerful multi-speed tool, with outstanding characteristics of exceptional manoeuvrability, rapid speed change, constant speeds, lightness in handling and fine finishing qualities.

At the touch of a finger, 3,000, 9,000 or 15,000 r.p.m. can be produced. Drives to three separate shafts are incorporated, enabling the operator to carry out successive operations without the necessity of dismounting and mounting tools. Rotary files and cutters, mounted points, drum sanders, brushes, etc., can be used to their best advantage with this new machine.

Demonstrations are being arranged not only at the main works at Coventry, but in all principal centres throughout the country.

**Air and Fume Extraction**

Sole rights to manufacture Hudson hollow plastics industrial fans in the United Kingdom have been acquired by **Marston Excelsior Ltd.,** a subsidiary company of Imperial Chemical Industries Ltd., from the Hudson Engineering Corporation of Houston, Texas. The fans will be sold under the trade name "Marex."

Blades are made of woven glass cloth and pigmented epoxy resin, laminated as a one-piece moulding. These materials make a self-coloured blade, which is corrosion- and heat-resistant, while the method of construction gives blades of smooth surface, high strength, and low weight.

Applications include moving hot dry air through heat exchangers in desert areas, moving hot moist air from water cooling towers, moving corrosive-laden air from chemical process vats, and in large volume ventilation systems.

**Mayfair Showrooms**

Showrooms in Mayfair have been opened by **Pearson-Page-Jewsbury and Company Ltd.,** of Witton, Birmingham, for their ornamental brasswork. These are the first showrooms the company has had in the West End of London since the war, and it is hoped they will provide a convenient centre for trade with London, provincial and American buyers.

**Change of Address**

As from Tuesday, September 1, the address of the Bristol branch office of **The English Electric Company Ltd.** is changed to Equity and Law Building, 36-38 Baldwin Street, Bristol, 1. The telephone number remains the same (Bristol 27304). The Domestic Appliance Service Depot remains at 155 Whiteladies Road, Bristol, 8.

**Die-Casting Machine Sales**

The Glasgow office of **E.M.B. Co. Ltd.** has been moved to 17 Woodlands Road, Thornliebank, Glasgow. The new telephone number is Giffnock 0188.

**Preventing Industrial Accidents**

Regular surveys—designed to prevent accidents in industry from the use of worn or obsolete equipment—are being carried out on a nation-wide scale from the eight district headquarters of **British Oxygen Gases Limited.** All oxy-fuel gas equipment in use in many major industrial undertakings, as well as small factories and workshops throughout the country, is examined and reports made on its condition and operating efficiency.

The investigations, carried out as planned maintenance surveys and offered free of charge, are conducted by technicians who, apart from investigating and reporting on equipment, are also able to advise on greater operating efficiency with elimination of wastage and reduction in manufacturing costs.

**Titanium Production in America**

Production of titanium ingots in the United States totalled 1,290,319 lb. in June, compared with 1,597,727 lb. in May, according to the U.S. Bureau of the Census.

Domestic consumption amounted to 1,131,870 lb. of ingot in June, compared with 1,640,966 lb. in May.

The production of titanium mill products in June totalled 621,614 lb. For the first six months of 1959, total titanium mill products production aggregated 3,839,449 lb., as against 2,634,303 lb. in the first half of 1958.

**Imports of Zirconium Sponge**

The Board of Trade give notice that they are considering an application for the exemption from import duty of zirconium sponge.

# Men and Metals

Three directors of British Insulated Callender's Cables, **Mr. W. C. Handley, Mr. D. T. Hollingsworth** and **Mr. F. Waine,** have joined the board of Scottish Cables.

Following his appointment as Financial Controller of the Group last year, **Mr. Maurice Tattersfield,** A.C.A., has been elected to the board of The George Cohen 600 Group Ltd. His previous posts include those of director and secretary of Electro Hydraulics of Warrington, and of Conveyancer Fork Trucks Ltd.; director of the Brush Group of Companies; and managing director of Brush Electrical Engineering Ltd. Mr. Tattersfield is a Fellow of the British Institute of Management and was at one time a Governor of Loughborough College of Technology.

Elected a director and vice-president of the company at a recent meeting of the board of Aluminium Laboratories Limited in Montreal, **Dr. R. T. Parker** recently took charge of the Banbury and Geneva offices of the company in succession to **Mr. R. D. Hamer.** At the same meeting, **Dr. D. E. Thomas,** head of the Department of Patents and Contracts, was appointed an assistant secretary.

Formerly research manager at the company's Cheltenham factory, **Mr. K. Fearnside** has been appointed to the board of Smiths Aircraft Instruments Ltd. as director of research. After working at the Atomic Energy Research Establishment, Harwell, where he did work in basic nuclear physics and the application of radioactive isotopes for industrial purposes, Mr. Fearnside became technical director of Isotope Developments Limited, and joined Smiths Aviation Division in June 1953.

A member of the Hall-Thermotank group of companies, Axia Fans Ltd. have appointed **Mr. G. B. Perry** as managing director. He has also been appointed a director of Vent-Axia Ltd., and will retain his seat on the board of Thermotank Ltd., with which company he formerly held the executive posts of director, Engineering Division, and general manager of its International Products Division.

As a result of Mr. Perry's appointment, **Mr. R. C. Adie** has been promoted to be general manager of Thermotank's International Products Division, and **Mr. H. J. Watson** will be general manager of the Engineering Division.

As works manager of the roll foundry, Davy and United Roll Foundry, Billingham, Co. Durham, have appointed **Mr. A. C. Bird,** with effect as from September 1. Mr. Bird had previously been the foundry's assistant works manager.

Appointed as a director of Wilmot-Breeden (Holdings) Ltd. is **Mr. T. J. Cross.**

Staff appointments in London and Manchester have been made by Griffin and George Ltd.; **Mr. Edward Bentley** is leaving Manchester to become London branch manager; **Mr. Kenneth Freer** becomes manager at the Manchester branch, and **Mr. James Branson** moves from Yorkshire to Manchester as assistant branch manager.

Having been general manager of Invicta Electrodes Ltd., of Willenhall for a number of years, **Mr. R. T. Bromfield** has been appointed managing director of the company.

## Forthcoming Meetings

**September 9—The Institution of Production Engineers.** North Western Region. Liverpool Graduate Lecture Hall of the Y.M.C.A., Mount Pleasant, Liverpool. "Quality Control." W. MacCrimmon. 7.30 p.m.

# Metal Market News

PROBABLY due to the printing strike, the June figures published by the British Bureau of Non-ferrous Metal Statistics were published rather later than usual, but the details show an all-round improvement on May. In copper, for example, consumption of refined metal was 44,761 tons against 33,367 tons in May. Secondary copper dropped from 14,253 tons to 11,351 tons in June but, as will be seen, the June total at 56,112 tons was up by 8,500 tons. Stocks improved from 78,505 tons at May 31 to 81,477 tons at the end of June. In lead, stocks were reduced, the total of 63,135 tons at May 31 declining to 57,810 tons at the end of June. Consumption, on the other hand, improved from 27,280 tons to 30,099 tons in June. Consumption of zinc was also up by fully 4,000 tons, the relative figures being 26,167 tons in May and 30,221 tons in June. Stocks were 38,297 tons, an increase of 584 tons. Usage of tin at 2,018 tons showed a rise of about 300 tons over May, while stocks, at 9,638 tons, were up by nearly 200 tons. These figures are certainly very good, but it must not be overlooked that May was a relatively poor month. However, with copper usage, on the basis of refined metal, running at the rate of over half a million tons per annum, there is obviously not much to bother about since this rate is certainly nearly twice what we were accustomed to see in pre-war days. L.M.E. stocks last week advanced by 690 tons to 15,728 tons, and it was probably due to this that the backwardation narrowed from 35s. to only 15s. on Tuesday last week.

Following the annual holidays, consumption at the various plants has now got into its stride again and there does not seem to be any reason why things should not continue at a good rate over the rest of the year. Naturally, this depends upon the requisite copper being available, but U.K. fabricators with their long term contracts should be reasonably well placed. As the market primed up last week, the backwardation increased till it reached 30s. on Thursday, when some 2,000 tons changed hands at midday. The previous afternoon, values were firm on talk of excessive wage demands by Braden workers, with whom a new agreement is due for ratification at the end of next month. There was also talk of buying by Iron Curtain countries. On the whole, business with users was rather better last week, and it begins to look as though a rather more serious view was being taken of the likely duration of the U.S. strike. Certainly, the news is far from encouraging at the time of writing.

Considerable interest has been aroused by the report that as from January 1 a change in the constitution of the standard copper contract on the L.M.E. will result in the discount for cathodes delivered against the contract being reduced from £3 to £1. This should certainly act as an incentive to sellers of this type of copper. Fire refined 99·88 per cent remains at £3 under the market quotation. Trading on Friday's midday market was no more than 1,200 tons, but the cash price advanced by £3 10s. 0d. from the previous afternoon to £236, with three months at £233 15s. 0d., the backwardation therefore being £2 5s. 0d. In the afternoon, the market was even firmer with cash at £236 15s. 0d., and three months at £234 10s. 0d. On a turnover of 12,445 tons, cash closed £3 5s. 0d. up on the week, and forward £2 15s. 0d., the backwardation being £2 5s. 0d. Tin was unchanged at £793, both positions on a turnover of 475 tons. Lead lost 22s. 6d. August, and 12s. 6d. November, 6,425 tons changing hands to close at £72 5s. 0d. and £73 15s. 0d. for the respective positions. Zinc was up 10s. August at £86 10s. 0d., and also 10s. better for November at £85. The turnover was about 5,000 tons.

### New York

Towards the middle of last week, Commodity Exchange copper was softer on selling influenced by the decline in London and quiet conditions in physical copper here.

The volume of dealings was fair. Dealers reported negligible consumer interest in copper, even at 32½ cents, consumers being well covered for the time being.

Lead sales were quiet, while zinc business was reported as excellent. Lead futures were barely steady. Tin was quiet and steady.

At the week end Commodity Exchange copper was firm and nearbys were up more than half a cent on covering and new buying in active dealings. Lead and zinc futures were steady. Copper traders showed interest in the terms of the American Metal subsidiary settlement giving a 21·6 cents package wage increase over two years, but expressed doubt that the Carteret settlement means a major break in the dispute.

Meanwhile, dealers and American Metal Climax indicate fair to active buying interest by consumers today in copper. Sales at from 33 to 33½ cents per lb. were reported. American Metals are selling not as a custom smelter, but as a merchant or agent for copper producers.

Tin was quiet but steady. Lead and zinc were moderately active.

The price of silver held unchanged at 91⅝ cents a fine ounce. Demand has been satisfactory for the time of year, but big users have found it necessary to buy from the U.S. Mint because commercial sellers have had their intake sharply reduced by strikes.

The General Services Administration announced in Washington that under agreements reached with the International Nickel Company of Canada, Limited, the U.S. would be relieved of all existing obligations to purchase nickel from that company for the Government stockpile.

### Birmingham

Industrial activity is rising gradually in the Midland area and, now that the peak of the holiday season is over, manufacturers look forward with confidence to steady trade over the remainder of the year. Engineering industries are steadily employed. New contracts recently given out for railway rolling stock will help local factories engaged on this class of work, following a period during which operations in the building shops were below capacity. In heavy electrical engineering the outlook is satisfactory, and several firms are engaged on contracts for nuclear power stations. The building trade is extending its demands for ferrous and non-ferrous castings.

Improvement in the iron and steel industry is closely connected with the motor trade, which has increased its buying of steel sheets and iron castings. In the recovery which has taken place in output of iron castings this year, the Midland area figures compare favourably with every other district. There has also been improvement in the demand for tubes and pipes for the oil industry. Steel mills have better order books for all classes of light steel, but particularly sheets and strip. Demand for heavy steel joists and sections lags behind somewhat in comparison with the rest of the trade.

### Paris

During the past week, activity was still reduced on the Paris scrap market, as a result of the summer holidays. A firmer tone was evident, however, for copper and brass in unison with foreign advices. Other scrap metals were neglected.

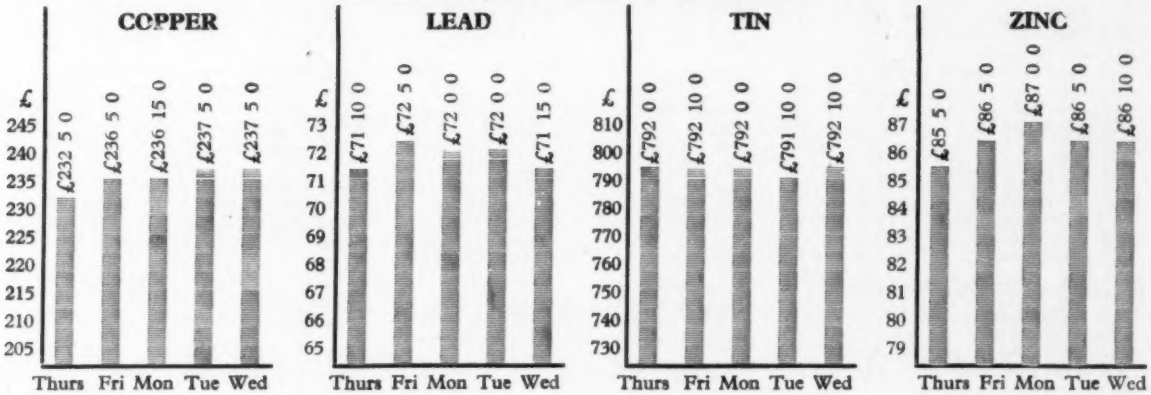
### Zurich

On the Swiss precious metal market, turnover continued to increase in the past week. According to trade sources the increase was due, in part, to purchases by the watch, jewellery and electrical industry for the Christmas trade. The largest increase was registered in demand for silver and gold, but there was also a slight increase in buyers' interest in palladium. Trade in platinum remained weak, but trade circles believe the usual increase in demand for platinum for the jewellery trade in the autumn will result in a pick up in trading.

# Non-Ferrous Metal Prices

## London Metal Exchange

Thursday 27 August to Wednesday 2 September 1959




## Primary Metals

All prices quoted are those available at 2 p.m. 2/9/59

| | | £ | s. | d. |
|---|---|---|---|---|
| **Aluminium** Ingots | ton | 180 | 0 | 0 |
| **Antimony** 99·6% | „ | 197 | 0 | 0 |
| **Antimony** Metal 99% | „ | 190 | 0 | 0 |
| **Antimony** Oxide | „ | 180 | 0 | 0 |
| **Antimony** Sulphide Lump | „ | 190 | 0 | 0 |
| **Antimony** Sulphide Black Powder | „ | 205 | 0 | 0 |
| **Arsenic** | „ | 400 | 0 | 0 |
| **Bismuth** 99·95% | lb. | | 16 | 0 |
| **Cadmium** 99·9% | „ | | 9 | 0 |
| **Calcium** | „ | 2 | 0 | 0 |
| **Cerium** 99% | „ | 16 | 0 | 0 |
| **Chromium** | „ | | 6 | 11 |
| **Cobalt** | „ | | 14 | 0 |
| **Columbite** | per unit | | — | |
| **Copper** H.C. Electro | ton | 237 | 5 | 0 |
| Fire Refined 99·70% | „ | 236 | 5 | 0 |
| Fire Refined 99·50% | „ | 235 | 5 | 0 |

| | | £ | s. | d. |
|---|---|---|---|---|
| **Copper Sulphate** | ton | 76 | 0 | 0 |
| **Germanium** | grm. | | — | |
| **Gold** | oz. | 12 | 10 | 5 |
| **Indium** | „ | | 10 | 0 |
| **Iridium** | „ | 24 | 0 | 0 |
| **Lanthanum** | grm. | | 15 | 0 |
| **Lead** English | ton | 71 | 15 | 0 |
| **Magnesium** Ingots | lb. | | 2 | 3 |
| Notched Bar | „ | | 2 | 9½ |
| Powder Grade 4 | „ | | 6 | 1 |
| Alloy Ingot, A8 or AZ91 | „ | | 2 | 4 |
| **Manganese Metal** | ton | 245 | 0 | 0 |
| **Mercury** | flask | 72 | 0 | 0 |
| **Molybdenum** | lb. | 1 | 10 | 0 |
| **Nickel** | ton | 600 | 0 | 0 |
| F. Shot | lb. | | 5 | 5 |
| F. Ingot | „ | | 5 | 6 |
| **Osmium** | oz. | | nom. | |
| **Osmiridium** | „ | | nom. | |

| | | £ | s. | d. |
|---|---|---|---|---|
| **Palladium** | oz. | 7 | 5 | 0 |
| **Platinum** | „ | 28 | 10 | 0 |
| **Rhodium** | „ | 41 | 0 | 0 |
| **Ruthenium** | „ | 18 | 0 | 0 |
| **Selenium** | lb. | | nom. | |
| **Silicon** 98% | ton | | nom. | |
| **Silver** Spot Bars | oz. | | 6 | 6¾ |
| **Tellurium** | lb. | | 15 | 0 |
| **Tin** | ton | 792 | 10 | 0 |
| ***Zinc** | | | | |
| Electrolytic | ton | | — | |
| Min 99·99% | „ | | — | |
| Virgin Min 98% | „ | 85 | 13 | 9 |
| Dust 95/97% | „ | 114 | 0 | 0 |
| Dust 98/99% | „ | 120 | 0 | 0 |
| Granulated 99+% | „ | 110 | 13 | 9 |
| Granulated 99·99+% | „ | 124 | 5 | 0 |

** Duty and Carriage to customers' works for buyers' account.*

## Foreign Quotations

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

| | **Belgium** fr/kg ≏£/ton | **Canada** c/lb ≏£/ton | **France** fr/kg ≏£/ton | **Italy** lire/kg ≏£/ton | **Switzerland** fr/kg ≏£/ton | **United States** c/lb ≏£/ton |
|---|---|---|---|---|---|---|
| **Aluminium** | | 22.50 185 17 6 | 225 168 0 | 375 221 5 | 2.50 212 10 | 26.80 214 10 |
| **Antimony** 99.0 | | | 220 163 0 | 445 262 10 | | 29.00 232 0 |
| **Cadmium** | | | 1,300 975 0 | | | 120.00 960 0 |
| **Copper** | | | | | | |
| Crude | | | | 445 262 12 6 | | |
| Wire bars 99.9 | | | | | | |
| Electrolytic | 32.50 239 5 0 | 29.00 238 12 6 | 324 243 0 | | 2.75 233 17 6 | 30.00 240 0 |
| **Lead** | | 10.50 86 15 | 106 79 10 | 165 97 7 6 | .88 74 17 6 | 13.00 104 0 |
| **Magnesium** | | | | | | |
| **Nickel** | | 70.00 578 5 | 900 675 0 | 1,200 708 0 | 7.50 637 10 | 74.00 592 0 |
| **Tin** | 112.25 826 2 6 | | 1,123 842 5 | 1,500 885 0 | 9.70 824 12 6 | 102.50 820 0 |
| **Zinc** | | | | | | |
| Prime western | | 11.50 95 0 0 | | | | 11.00 88 0 |
| High grade 99.95 | | 12.10 100 0 0 | | | | |
| High grade 99.99 | | 12.50 103 2 6 | | | | |
| Thermic | | | 124.00 93 0 | | | |
| Electrolytic | | | 132.00 99 0 | 191 112 12 6 | 1.05 89 2 6 | 12.25 98 0 |

# Non-Ferrous Metal Prices (continued)

## Ingot Metals

All prices quoted are those available at 2 p.m. 2/9/59

| | | £ | s. | d. |
|---|---|---|---|---|
| **Aluminium Alloy (Virgin)** | | | | |
| B.S. 1490 L.M.5 | ton | 210 | 0 | 0 |
| B.S. 1490 L.M.6 | „ | 202 | 0 | 0 |
| B.S. 1490 L.M.7 | „ | 216 | 0 | 0 |
| B.S. 1490 L.M.8 | „ | 203 | 0 | 0 |
| B.S. 1490 L.M.9 | „ | 203 | 0 | 0 |
| B.S. 1490 L.M.10 | „ | 221 | 0 | 0 |
| B.S. 1490 L.M.11 | „ | 215 | 0 | 0 |
| B.S. 1490 L.M.12 | „ | 223 | 0 | 0 |
| B.S. 1490 L.M.13 | „ | 216 | 0 | 0 |
| B.S. 1490 L.M.14 | „ | 224 | 0 | 0 |
| B.S. 1490 L.M.15 | „ | 210 | 0 | 0 |
| B.S. 1490 L.M.16 | „ | 206 | 0 | 0 |
| B.S. 1490 L.M.18 | „ | 203 | 0 | 0 |
| B.S. 1490 L.M.22 | „ | 210 | 0 | 0 |
| **†Aluminium Alloys (Secondary)** | | | | |
| B.S. 1490 L.M.1 | ton | 153 | 0 | 0 |
| B.S. 1490 L.M.2 | „ | 163 | 0 | 0 |
| B.S. 1490 L.M.4 | „ | 178 | 0 | 0 |
| B.S. 1490 L.M.6 | „ | 189 | 0 | 0 |
| ***Aluminium Bronze** | | | | |
| BSS 1400 AB.1 | ton | 236 | 0 | 0 |
| BSS 1400 AB.2 | „ | 247 | 0 | 0 |

| | | £ | s. | d. |
|---|---|---|---|---|
| ***Brass** | | | | |
| BSS 1400-B3 65/35 | ton | 156 | 6 | 0 |
| BSS 249 | „ | — | | |
| BSS 1400-B6 85/15 | „ | 200 | 0 | 0 |
| ***Gunmetal** | | | | |
| R.C.H. 3/4% ton | „ | — | | |
| (85/5/5/5) LG2 | „ | 193 | 0 | 0 |
| (86/7/5/2) LG3 | „ | 203 | 0 | 0 |
| (88/10/2/1) | „ | 242 | 0 | 0 |
| (88/10/2/½) | „ | 253 | 0 | 0 |
| ***Manganese Bronze** | | | | |
| BSS 1400 HTB1 | „ | 185 | 0 | 0 |
| BSS 1400 HTB2 | „ | 202 | 0 | 0 |
| BSS 1400 HTB3 | „ | 214 | 0 | 0 |
| **Nickel Silver** | | | | |
| Casting Quality 12% | „ | 230 | 0 | 0 |
| „ „ 16% | „ | 232 | 0 | 0 |
| „ „ 18% | „ | 250 | 0 | 0 |
| ***Phosphor Bronze** | | | | |
| B.S. 1400 P.B.1.(A.I.D. released) | „ | 289 | 0 | 0 |
| B.S. 1400 L.P.B.1 | „ | 213 | 0 | 0 |

**Average prices for the last week-end.*

| | | £ | s. | d. |
|---|---|---|---|---|
| **Phosphor Copper** | | | | |
| 10% | ton | 253 | 0 | 0 |
| 15% | „ | 255 | 10 | 0 |
| **Phosphor Tin** | | | | |
| 5% | „ | — | | |
| **Silicon Bronze** | | | | |
| BSS 1400-SB1 | „ | 240 | 0 | 0 |
| **Solder, soft, BSS 219** | | | | |
| Grade C Tinmans | „ | 369 | 5 | 0 |
| Grade D Plumbers | „ | 297 | 5 | 0 |
| Grade M | „ | 405 | 0 | 0 |
| **Solder, Brazing, BSS 1845** | | | | |
| Type 8 (Granulated) | lb. | — | | |
| Type 9 „ | „ | — | | |
| **Zinc Alloys** | | | | |
| Mazak III | ton | 117 | 10 | 0 |
| Mazak V | „ | 121 | 10 | 0 |
| Kayem | „ | 127 | 10 | 0 |
| Kayem II | „ | 133 | 10 | 0 |
| Sodium-Zinc | lb. | | 2 | 7½ |

## Semi-Fabricated Products

Prices vary according to dimensions and quantities. The following are the basis prices for certain specific products.

| | | | £ | s. | d. |
|---|---|---|---|---|---|
| **Aluminium** | | | | | |
| Sheet 10 S.W.G. | lb. | | 2 | 8½ | |
| Sheet 18 S.W.G. | „ | | 2 | 10½ | |
| Sheet 24 S.W.G. | „ | | 3 | 1½ | |
| Strip 10 S.W.G. | „ | | 2 | 8½ | |
| Strip 18 S.W.G. | „ | | 2 | 9½ | |
| Strip 24 S.W.G. | „ | | 2 | 11 | |
| Circles 22 S.W.G. | „ | | 3 | 2½ | |
| Circles 18 S.W.G. | „ | | 3 | 1½ | |
| Circles 12 S.W.G. | „ | | 3 | 0½ | |
| Plate as rolled | „ | | 2 | 8 | |
| Sections | „ | | 3 | 2 | |
| Wire 10 S.W.G. | „ | | 2 | 11½ | |
| Tubes 1 in. o.d. 16 S.W.G. | „ | | 4 | 1 | |
| **Aluminium Alloys** | | | | | |
| BS1470. HS10W. | | | | | |
| Sheet 10 S.W.G. | „ | | 3 | 1 | |
| Sheet 18 S.W.G. | „ | | 3 | 3½ | |
| Sheet 24 S.W.G. | „ | | 3 | 11 | |
| Strip 10 S.W.G. | „ | | 3 | 1 | |
| Strip 18 S.W.G. | „ | | 3 | 2½ | |
| Strip 24 S.W.G. | „ | | 3 | 10½ | |
| BS1477. HP30M. | | | | | |
| Plate as rolled | „ | | 2 | 11 | |
| BS1470. HC15WP. | | | | | |
| Sheet 10 S.W.G. | „ | | 3 | 9½ | |
| Sheet 18 S.W.G. | „ | | 4 | 2 | |
| Sheet 24 S.W.G. | „ | | 5 | 0½ | |
| Strip 10 S.W.G. | „ | | 3 | 10½ | |
| Strip 18 S.W.G. | „ | | 4 | 2 | |
| Strip 24 S.W.G. | „ | | 4 | 9½ | |
| BS1477. HPC15WP. | | | | | |
| Plate heat treated | „ | | 3 | 6½ | |
| BS1475. HG10W. | | | | | |
| Wire 10 S.W.G. | „ | | 3 | 10½ | |
| BS1471. HT10WP. | | | | | |
| Tubes 1 in. o.d. 16 S.W.G. | „ | | 5 | 0½ | |
| BS1476. HE10WP. | | | | | |
| Sections | „ | | 3 | 1½ | |
| **Brass** | | | | | |
| Tubes | „ | | 1 | 10½ | |
| Brazed Tubes | „ | | 3 | 0½ | |
| Drawn Strip Sections | „ | | 3 | 1 | |
| Sheet | ton | 202 | 10 | 0 | |
| Strip | „ | 202 | 10 | 0 | |
| Extruded Bar | lb. | | 2 | 2½ | |
| Extruded Bar (Pure Metal Basis) | „ | | — | | |

| | | £ | s. | d. |
|---|---|---|---|---|
| **Brass** | | | | |
| Condenser Plate (Yellow Metal) | ton | 193 | 0 | 0 |
| Condenser Plate (Naval Brass) | „ | 204 | 0 | 0 |
| Wire | lb. | | 2 | 8½ |
| **Beryllium Copper** | | | | |
| Strip | „ | 1 | 4 | 11 |
| Rod | „ | 1 | 1 | 6 |
| Wire | „ | 1 | 4 | 9 |
| **Copper** | | | | |
| Tubes | lb. | | 2 | 3½ |
| Sheet | ton | 268 | 5 | 0 |
| Strip | „ | 268 | 5 | 0 |
| Plain Plates | „ | — | | |
| Locomotive Rods | „ | — | | |
| H.C. Wire | „ | — | | |
| **Cupro Nickel** | | | | |
| Tubes 70/30 | lb. | | 3 | 6⅞ |

| | | £ | s. | d. |
|---|---|---|---|---|
| **Lead** | | | | |
| Pipes (London) | ton | 111 | 5 | 0 |
| Sheet (London) | „ | 109 | 0 | 0 |
| Tellurium Lead | „ | £6 extra | | |
| **Nickel Silver** | | | | |
| Sheet and Strip 7% | lb. | | 3 | 8½ |
| Wire 10% | „ | | 4 | 3¼ |
| **Phosphor Bronze** | | | | |
| Wire | „ | | 4 | 1½ |
| **Titanium** (1,000 lb. lots) | | | | |
| Billet 4½″ to 18″ dia. | lb. | 54/- | 55/- | |
| Rod ¼″ to 4″ dia. | „ | 95/- | 62/- | |
| Wire ·036″ – ·232″ dia. | „ | 167/- | 110/- | |
| Strip ·003″ to ·048″ | „ | 200/- | 75/- | |
| Sheet 8′×2′. 20 gauge | „ | 85/- | | |
| Tube, representative average gauge | „ | 300/- | | |
| Extrusions | „ | 105/- | | |
| **Zinc** | | | | |
| Sheet | ton | 121 | 15 | 0 |
| Strip | „ | nom. | | |

# Domestic and Foreign

Merchants' average buying prices delivered, per ton, 1/9/59.

| | £ |
|---|---|
| **Aluminium** | |
| New Cuttings | 145 |
| Old Rolled | 126 |
| Segregated Turnings | 99 |
| **Brass** | |
| Cuttings | 158 |
| Rod Ends | 148 |
| Heavy Yellow | 123 |
| Light | 117 |
| Rolled | 150 |
| Collected Scrap | 120 |
| Turnings | 142 |
| **Copper** | |
| Wire | 213 |
| Firebox, cut up | 206 |
| Heavy | 201 |
| Light | 195 |
| Cuttings | 213 |
| Turnings | 196 |
| Braziery | 163 |

| | £ |
|---|---|
| **Gunmetal** | |
| Gear Wheels | 178 |
| Admiralty | 178 |
| Commercial | 162 |
| Turnings | 157 |
| **Lead** | |
| Scrap | 63 |
| **Nickel** | |
| Cuttings | — |
| Anodes | 550 |
| **Phosphor Bronze** | |
| Scrap | 162 |
| Turnings | 157 |
| **Zinc** | |
| Remelted | 74 |
| Cuttings | 57 |
| Old Zinc | 38 |

# Financial News

**Albright and Wilson Ltd.**

In the six months to June 30, 1959, group net profit rose to £1,122,000 from £793,000 in the corresponding period of 1958. The 1958 full year's net profit was £1,787,000.

Unaudited results, six months to June 30: trading profit £3,328,000 (£2,453,000), depreciation £1,103,000 (£911,000), taxation £1,103,000 (£749,000), group net profit £1,122,000 (£793,000).

**The Antiference Group**

Group net profit for the year to March 31, 1959, was £278,202 (£263,686). Dividend of 40 per cent (same). Fixed assets £404,215 (£293,773). Net current assets £1,000,476 (£933,123). Reserves £777,571 (£557,105). Future tax £189,400 (£232,071). Commitments £61,000.

**British Titan Products Company**

Group trading profit, 1958, amounted to £4,127,431 (£3,589,440). After depreciation of £1,245,406 (£1,021,766), and special depreciation of £550,000 (nil), tax £864,914 (£1,189,907), etc., the net profit was £1,312,198 (£1,199,002). £322,000 (£554,000) is being placed in reserves, dividends £833,482 (£558,708), forward £526,884 (£370,168). Net current assets £4,075,931 (£3,805,165). Fixed assets £10,812,044 (£9,966,156). Commitments £1,072,262.

**Murex Ltd.**

Group net profits (1958-59) of £334,034 compared with £291,650. Dividend cut 2½ per cent to 15 per cent. Fixed assets rose from £2,671,432 to £2,880,269. Net current assets £3,755,880 (£3,892,260). Net assets £6,776,185 (£6,688,728).

**John G. Stein**

Interim dividend of 5 per cent is being paid on £1¼ million Ordinary capital.

**Monsanto Chemicals**

Net sales amounted to £8,726,720 for the first half of 1959, compared with £7,489,848 for the corresponding 1958 period.

Net income for the six months was £371,611 (£247,642), after charging estimated taxes of £348,400 (£284,100).

A maintained interim of 5 per cent is declared on the £5·4m. Ordinary capital. The previous year's total was 13½ per cent.

**Manley and Regulus Ltd.**

Dividend 12½ per cent (same). Net profit (parent company) year to April 30, 1959, is £32,706 (£18,000). Fixed assets of subsidiaries £200,955 (£203,515), current assets £265,597 (£299,856), and liabilities £149,572. (£155,443). Parent assets: Fixed £92,557 (£93,451), subsidiaries £144,725 (£137,302), investments £142,895 (£143,809), and current £236,047 (£214,354). Liabilities £121,836 (£96,915).

# New Companies

**The particulars of companies recently registered are quoted from the daily register compiled by Jordan and Sons Limited, Company Registration Agents, Chancery Lane, W.C.2.**

**H. B. Fillers Limited** (632213), 293 Etruria Road, Etruria, Stoke-on-Trent. Registered July 8, 1959. To carry on business of manufacturers of and dealers in ceramic and refractory materials and preformed sections used in the foundry, mining industry and manufacture of paints, vitreous enamels, etc. Nominal capital, £5,000 in £1 shares. Directors: Harold J. Horton, Jocelyn Horton, Geo. Benbow and Marjorie Benbow.

**Ilfex Metals Limited** (632644), 185 Wardour Street, W.1. Registered July 14, 1959. To carry on business of research workers, specialists and advisers in connection with heat and other treatment of metals, etc. Nominal capital, £100 in £1 shares. Directors: Michael K. Kaye and Ronald D. K. Kaye.

**Pressure Moulds (Birmingham) Limited** (632733), 559 Birmingham Road, Bromsgrove, Worcs. Registered July 15, 1959. To carry on business of mechanical and general engineers, etc. Nominal capital, £100 in £1 shares. Directors: John A. Middleton, Zena M. Middleton and Frank F. Healey.

**Imperial Aluminium Company Limited** (632328), Barrington House, 59-67 Gresham Street, E.C.2. Registered July 23, 1959. Nominal capital, £2,695,000 in £1 shares. Directors not named.

**Southern Metal Products (Peacehaven) Limited** (632991), 27 South Coast Road, Peacehaven, Sussex Registered July 17, 1959. To take over the business of precision engineers known as Southern Metal Products carried on at Sunview Ave., Peacehaven, by L. G. C. Gillett. Nominal capital, £200 in £1 shares. Directors: Leslie G. C. Gillett and Mrs. Barbara H. Gillett.

**Barbican Metal Co. Limited** (633178), 4 New Zealand Ave., Barbican, E.C.1. Registered July 21, 1959. Nominal capital, £100 in £1 shares. Director: Mrs. Lily Barker.

**Chesham Electro Plating Company Limited** (633357), 1a Bois Moor Road, Chesham, Bucks. Registered July 23, 1959. To take over business carried on at Chesham as Chesham Electro Plating Company, etc. Nominal capital, £300 in £1 shares. Directors: James H. Baars, Gordon L. Stevenson and Albert H. Jiggins.

**Redditch Industrial Finishing Developments Limited** (633512), Beoley Mill, Beoley Road, Redditch, Worcs. Registered July 24, 1959. Nominal capital, £6,000 in £1 shares. Directors: Richard Bennett and Albert G. Griffin.

# Trade Publications

**About Crucibles.**—The Morgan Crucible Company Limited, Battersea Church Road, London, S.W.11.

A useful three-fold brochure in colour has been issued under the title of "Your Crucible," and is intended as a general guide for the care and use of crucibles. It has been made as concise as possible and is designed to help the foundryman to get the best from his crucibles and maximum efficiency from crucible melting.

**Keetona Shears.** — Keeton Sons and Company Limited, Greenland Road, Sheffield, 9.

This booklet details the new "Keetona" ¼ in. shear, which incorporates many new features such as instantaneous clutch engagement, easy accessibility for blade changing, efficient one-point lubrication, and toggle action mechanical hold-down, or, alternatively, hydraulically-operated hold-down.

**Ficep Shearing Machines.**—Thos. W. Ward Limited, Albion Works, Sheffield.

New literature has just been issued dealing with these machines, giving specifications, illustrations and considerable data. It should be noted that Thos. W. Ward Limited are the sole U.K. distributors of these machines.

**Controlled Heat and Air.**—The Incandescent Heat Company Ltd., Cornwall Road, Smethwick, Birmingham.

A new bulletin issued by this company deals with processing equipment for the electrical industries. Emphasis is placed on the "Chal" plant, which is available for use in such processes as coating and baking, transformer drying, paint drying, enamel drying for copper wire, and insulator drying, etc. A number of illustrations are included showing plant installed.

# Scrap Metal Prices

**The figures in brackets give the English equivalents in £1 per ton:—**

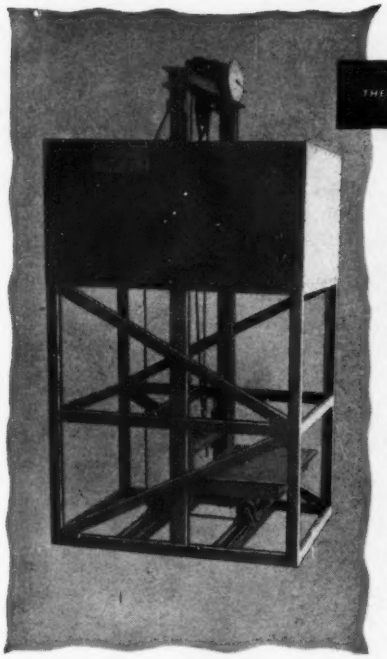
| | | |
|---|---|---|
| **West Germany** (D-marks per 100 kilos): | | |
| Used copper wire .. | (£205.17.6) | 235 |
| Heavy copper .... | (£201.10.0) | 230 |
| Light copper ..... | (£170.17.6) | 195 |
| Heavy brass ..... | (£118.5.0) | 135 |
| Light brass ..... | (£96.12.6) | 105 |
| Soft lead scrap .... | (£56.0.0) | 64 |
| Zinc scrap ..... | (£38.12.6) | 44 |
| Used aluminium unsorted ..... | (£105.2.6) | 120 |
| **France** (francs per kilo): | | |
| Electrolytic copper scrap ..... | (£187.12.6) | 250 |
| Heavy copper .... | (£187.12.6) | 250 |
| No. 1 copper wire .. | (£172.12.6) | 230 |
| Light brass ..... | (£122.0.0) | 160 |
| Zinc castings ..... | (£51.0.0) | 68 |
| Lead ..... | (£69.0.0) | 92 |
| Aluminium ..... | (£129.12.6) | 173 |
| **Italy** (lire per kilo): | | |
| Aluminium soft sheet clippings (new) .. | (£200.15.0) | 340 |
| Aluminium copper alloy | (£132.17.6) | 225 |
| Lead, soft, first quality | (£77.5.0) | 131 |
| Lead, battery plates | (£43.0.0) | 73 |
| Copper, first grade | (£221.5.0) | 375 |
| Copper, second grade | (£209.10.0) | 355 |
| Bronze, first quality machinery ..... | (£203.2.6) | 345 |
| Bronze, commercial gunmetal ..... | (£174.10.0) | 295 |
| Brass, heavy..... | (£144.10.0) | 245 |
| Brass, light ..... | (£237.17.6) | 225 |
| Brass, bar turnings .. | (£135.17.6) | 230 |
| New zinc sheet clippings ..... | (£65.0.0) | 110 |
| Old zinc ..... | (£50.2.6) | 85 |

# THE STOCK EXCHANGE

## *Turnover Continued Heavy And Prices Generally Well Maintained*

| ISSUED CAPITAL • | AMOUNT OF SHARE | NAME OF COMPANY | MIDDLE PRICE † SEPTEMBER +RISE—FALL | | DIV. FOR LAST FIN. YEAR | DIV. FOR PREV. YEAR | DIV. YIELD | 1959 HIGH | 1959 LOW | 1958 HIGH | 1958 LOW |
|---|---|---|---|---|---|---|---|---|---|---|---|
| £ | £ | | | | Per cent | Per cent | | | | | |
| 4,435,792 | 1 | Amalgamated Metal Corporation ... | 27/– | —3d. | 9 | 9 | 6 13 3 | 27/4½ | 23/3 | 24/9 | 17/6 |
| 400,000 | 2/– | Anti-Attrition Metal ... ... ... | 1/3 | | 4 | 8½ | 6 15 0 | 1/6 | 1/3 | 1/9 | 1/3 |
| 41,303 829 | Stk. (£1) | Associated Electrical Industries ... | 61/– | —1/– | 15 | 15 | 4 18 3 | 63/6 | 54/– | 58/9 | 46/6 |
| 1,613,280 | 1 | Birfield ... ... ... ... ... | 60/– | +6d. | 15 | 15 | 5 0 0 | 60/– | 46/9 | 62/4½ | 46/3 |
| 3,196,667 | 1 | Birmid Industries ... ... ... | 82/– | | 17½ | 17½ | 4 5 6 | 82/– | 72/– | 77/6 | 55/3 |
| 5,630,344 | Stk. (£1) | Birmingham Small Arms ... ... | 45/1½ | +1½d. | 11 | 10 | 4 17 6 | 48/3 | 36/1½ | 39/– | 23/9 |
| 203,150 | Stk. (£1) | Ditto Cum. A. Pref, 5% ... ... | 15/6 | | 5 | 5 | 6 9 0 | 16/3 | 15/– | 16/1½ | 14/7½ |
| 350,580 | Stk. (£1) | Ditto Cum. B. Pref. 6% ... ... | 18/10½ | | 6 | 6 | 6 7 0 | 18/10½ | 17/9 | 17/4½ | 16/6 |
| 500,000 | 1 | Bolton (Thos.) & Sons ... ... | 33/9 | | 10 | 10 | 5 18 6 | 34/– | 27/6 | 28/9 | 24/– |
| 300,000 | 1 | Ditto Pref. 5% ... ... ... | 15/6 | | 5 | 5 | 6 9 0 | 15/6 | 14/– | 16/– | 15/– |
| 160,000 | 1 | Booth (James) & Co. Cum. Pref. 7% | 20/6 | | 7 | 7 | 6 16 6 | 20/6 | 20/– | 20/4½ | 19/– |
| 1,500,000 | Stk. (£1) | British Aluminium Co. Pref 6% ... | 20/6 | | 6 | 6 | 5 17 6 | 20/7½ | 18/9 | 20/– | 18/4½ |
| 17,247,070 | Stk. (£1) | British Insulated Callender's Cables | 53/3 | | 12½ | 12½ | 4 14 0 | 57/– | 46/3 | 52/6 | 38/9 |
| 17,047,166 | Stk. (£1) | British Oxygen Co. Ltd., Ord. ... | 66/9 | +1/9 | 10 | 10 | 3 0 3 | 66/9 | 49/3 | 52/– | 28/3 |
| 1,200,000 | Stk. (5/–) | Canning (W.) & Co. ... ... ... | 15/1½ | —4½d. | 25+*2½C‡ | 25 | 4 2 6 | 16/– | 12/3 | 25/3 | 19/3 |
| 60,484 | 1/– | Carr (Chas.) ... ... ... ... | 2/9 | +1½d. | 12½ | 25 | 4 11 0 | 2/9 | 1/3 | 2/3 | 1/4½ |
| 555,000 | 1 | Clifford (Chas.) Ltd. ... ... ... | 27/– | +2/– | 10 | 10 | 7 8 3 | 26/6 | 22/6 | 22/– | 16/– |
| 45,000 | 1 | Ditto Cum. Pref. 6% ... ... | 17/– | +3d. | 6 | 6 | 7 1 3 | 16/9 | 15/3 | 16/– | 15/– |
| 250,000 | 2/– | Coley Metals ... ... ... ... | 3/– | | 15 | 20 | 10 0 0 | 4/– | 2/10½ | 4/6 | 2/6 |
| 10,185,696 | 1 | Cons. Zinc Corp.† ... ... ... | 67/6 | | 15 | 18‡ | 4 9 0 | 69/3 | 59/– | 65/3 | 41/– |
| 1,509,528 | 1 | Davy & United ... ... ... ... | 74/3 | +1/9 | 30‡ | 20 | 4 0 9 | 74/3 | 43/1½ | 87/– | 45/9 |
| 6,840,000 | 5/– | Delta Metal ... ... ... ... | 18/– | | 31‡ | 30 | 4 6 0 | 18/– | 12/– | 25/– | 17/7½ |
| 5,296,550 | Stk. (£1) | Enfield Rolling Mills Ltd. ... ... | 56/9 | | 15 | 12½ | 5 5 9 | 57/6 | 36/7½ | 38/– | 22/9 |
| 750,000 | 1 | Evered & Co. ... ... ... ... | 35/9 | | 10§ | 15Z | 5 12 0 | 35/9 | 30/– | 30/– | 26/ |
| 18,000,000 | Stk. (£1) | General Electric Co. ... ... ... | 38/3 | +3d. | 10 | 10P | 5 4 6 | 40/3 | 30/– | 40/6 | 29/6 |
| 1,500,000 | Stk. (10/–) | General Refractories Ltd. ... ... | 37/9 | +3d. | 20 | 20 | 5 6 0 | 40/– | 32/6 | 39/3 | 27/3 |
| 401,240 | 1 | Gibbons (Dudley) Ltd. ... ... | 64/– | +1/– | 16½ | 15 | 5 3 0 | 66/6 | 63/6 | 67/6 | 61/– |
| 750,000 | 5/– | Glacier Metal Co. Ltd. ... ... | 8/3 | | 11½ | 11½ | 6 18 9 | 9/3 | 6/7½ | 8/3 | 5/– |
| 1,750,000 | 5/– | Glynwed Tubes ... ... ... | 22/– | +6d. | 20 | 20 | 4 11 0 | 22/9 | 16/4½ | 18/1½ | 12/10½ |
| 5,421,049 | 10/– | Goodlass Wall & Lead Industries ... | 39/– | +3d. | 13‖ | 18Z | 3 6 9 | 39/– | 28/7½ | 30/9 | 17/3 |
| 342,195 | 1 | Greenwood & Batley ... ... | 105/– | | 30 | 20 | 5 14 3 | 108/3 | 75/– | 57/9 | 45/– |
| 396,000 | 5/– | Harrison (B'ham) Ord. ... ... | 19/7½ | —1½d. | *17½ | *15 | 4 9 3 | 20/– | 14/11½ | 15/9 | 11/6 |
| 150,000 | 1 | Ditto Cum. Pref. 7% ... ... | 19/3 | | 7 | 7 | 7 5 6 | — | — | 19/9 | 18/4½ |
| 1,075,167 | 5/– | Heenan Group ... ... ... | 9/10½ | —7½d. | 10 | 10‡ | 5 1 3 | 10/6 | 7/6 | 9/7½ | 6/9 |
| 236,958,260 | Stk. (£1) | Imperial Chemical Industries ... | 42/– | +2/– | 12Z | 10 | 3 16 3 | 42/9 | 33/9 | 38/– | 24/3 |
| 34,736,773 | Stk. (£1) | Ditto Cum. Pref. 5% ... ... | 17/9 | | 5 | 5 | 5 12 9 | 17/9 | 16/– | 17/1½ | 16/– |
| 14,584,025 | ** | International Nickel ... ... ... | 181 | —2 | $2.60 | $3.75 | 2 12 6 | 187⅜ | 154½ | 169 | 132⅜ |
| 300,000 | 1 | Johnson, Matthey & Co. Cum. Pref. 5% | 16/3 | | 5 | 5 | 6 3 0 | 16/3 | 15/4½ | 16/9 | 15/– |
| 6,000,000 | 1 | Ditto Ord ... ... ... ... | 43/9 | +2/3 | 12D | 10 | 3 13 3 | 43/9 | 29/7½ | 47/– | 36/6 |
| 600,000 | 10/– | Keith, Blackman ... ... ... | 31/3 | +1/3 | 17½E | 15 | 4 7 0 | 31/3 | 25/– | 28/9 | 15/– |
| 320,000 | 4/– | London Aluminium ... ... ... | 6/6 | +9d. | 10 | 10 | 6 3 0 | 6/9 | 5/3 | 6/– | 3/– |
| 765,012 | 1 | McKechnie Brothers Ord. ... ... | 41/3 | +3d. | 15 | 15 | 7 5 6 | 45/– | 41/– | 45/– | 32/– |
| 1,530,024 | 1 | Ditto A Ord. ... ... ... | 38/9 | | 15 | 15 | 7 14 6 | 43/6 | 38/9 | 45/– | 30/– |
| 1,108,268 | 5/– | Manganese Bronze & Brass ... ... | 14/6 | +3d. | 20$\frac{5}{10}$ | 20 | 7 3 6 | 16/3 | 13/9 | 14/1½ | 8/9 |
| 50,628 | 6/– | Ditto (7½% N.C. Pref.) ... ... | 6/– | | 7½ | 7½ | 7 10 0 | — | — | 6/3 | 5/6 |
| 13,098,855 | Stk (£1) | Metal Box ... ... ... ... | 60/3 | +1/9 | 11 | 11 | 3 13 0 | 60/4½ | 44/7½ | 73/3 | 40/6 |
| 415,760 | Stk. (2/–) | Metal Traders ... ... ... ... | 12/3 | +6d. | 50 | 50 | 8 3 3 | 12/3 | 8/4½ | 9/– | 6/3 |
| 160,000 | 1 | Mint (The) Birmingham ... ... | 27/6 | | 10 | 10 | 7 5 6 | 27/6 | 22/– | 22/9 | 19/– |
| 80,000 | 5 | Ditto Pref. 6% ... ... ... | 80/– | | 6 | 6 | 7 10 0 | 75/6 | 69/– | 83/6 | 69/– |
| 3,705,670 | Stk. (£1) | Morgan Crucible A ... ... ... | 56/6 | +1/3 | 10 | 10 | 3 10 9 | 56/6 | 43/6 | 45/– | 34/– |
| 1,000,000 | Stk. (£1) | Ditto 5½% Cum. 1st Pref. ... | 18/3 | | 5½ | 5½ | 6 0 6 | 18/6 | 17/6 | 18/– | 17/– |
| 2,200,000 | Stk. (£1) | Murex ... ... ... ... ... | 47/9 | +1/6 | 15 | 17½ | 6 5 9 | 51/– | 41/– | 58/9 | 46/– |
| 468,000 | 5/– | Ratcliffs (Great Bridge) ... ... | 11/6 | | 10R | 10 | 3 5 3 | 11/6 | 9/6 | 11/1½ | 6/10½ |
| 234,960 | 10/– | Sanderson Bros. & Newbould ... | 41/– | +1/– | 25 | 20 | 6 2 0 | 41/– | 27/9 | 27/3 | 24/6 |
| 1,365,000 | Stk. (5/–) | Serck ... ... ... ... ... | 23/– | | 15 | 17½ | 3 5 3 | 23/– | 18/– | 18/7½ | 11/– |
| 6,698,586 | Stk. (£1) | Stone-Platt Industries ... ... | 51/6 | | 15 | 15 | 5 12 3 | 53/6 | 42/6 | 45/6 | 22/6 |
| 2 928,963 | Stk. (£1) | Ditto 5½% Cum. Pref. ... ... | 17/6 | | 5½ | 5½ | 6 5 9 | 18/– | 15/10½ | 16/3 | 12/7½ |
| 18,255,218 | Stk. (£1) | Tube Investments Ord ... ... | 91/6 | +1/6 | 17½ | 15 | 3 16 6 | 91/6 | 72/– | 86/– | 48/4½ |
| 41,000,000 | Stk. (£1) | Vickers ... ... ... ... | 32/– | | 10 | 10 | 6 5 6 | 37/– | 29/9 | 36/3 | 28/9 |
| 750,000 | Stk. (£1) | Ditto Pref. 5% ... ... ... | 15/– | | 5 | 5 | 6 13 9 | 15/0‡ | 14/3 | 15/9 | 14/3 |
| 6,863,807 | Stk. (£1) | Ditto Pref. 5% tax free ... ... | 22/– | | *5 | *5 | 6 15 3A | 22/7½ | 20/6 | 23/– | 21/3 |
| 2,200,000 | 1 | Ward (Thos. W.), Ord. ... ... | 100/9 | +2/3 | 20 | 15 | 3 19 6 | 100/9 | 83/– | 87/3 | 70/9 |
| 2,666,034 | Stk. (£1) | Westinghouse Brake ... ... ... | 45/6 | +1/– | 10 | 10 | 4 8 0 | 47/– | 39/9 | 46/6 | 32/6 |
| 225,000 | 2/– | Wolverhampton Die-Casting ... | 10/1½ | | 30 | 25 | 5 18 6 | 10/6 | 8/8½ | 10/1½ | 7/– |
| 591,000 | 5/– | Wolverhampton Metal ... ... | 32/3 | +1/3 | 27½ | 27½ | 4 5 3 | 32/3 | 21/6 | 22/9 | 14/9 |
| 78,465 | 2/6 | Wright, Bindley & Gell ... ... | 7/1½ | +1½d. | 20 | 20 | 6 18 0 | 7/1½ | 4/11½ | 5/4½ | 2/9 |
| 124,140 | 1 | Ditto Cum. Pref. 6% ... ... | 13/9 | | 6 | 6 | 8 14 9 | 13/9 | 13/6 | 13/– | 11/3 |
| 150,000 | 1/– | Zinc Alloy Rust Proof ... ... | 3/6 | —3d. | 27 | 40D | 7 14 3 | 3/9 | 2/9 | 3/1½ | 2/7½ |

•Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. **Shares of no Par Value. ‡ and 100% Capitalized issue. • The figures given relate to the issue quoted in the third column. A Calculated on £7 8 9 gross. Y Calculated on 11½% dividend. ‖Adjusted to allow for capitalization issue. E for 15 months. D and 50% capitalized issue. Z and 50% capitalized issue. B equivalent to 12½% on existing Ordinary Capital after 100% capitalized issue. ϕ And 100% capitalized issue. X Calculated on 17½%. C Paid out of Capital Profits. E and 50% capitalized issue in 7% 2nd Pref. Shares. P Interim dividend since reduced. § And Special distribution of 2½% free of tax. R And 33⅓% capitalized issue in 8% Maximum Ordinary 5/– Stock Units.



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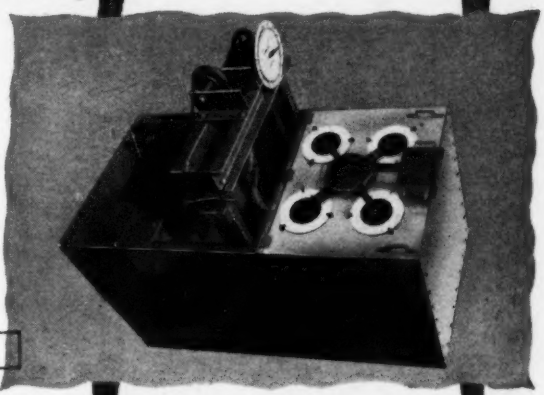

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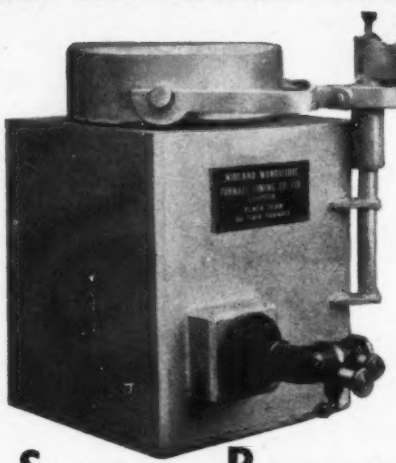

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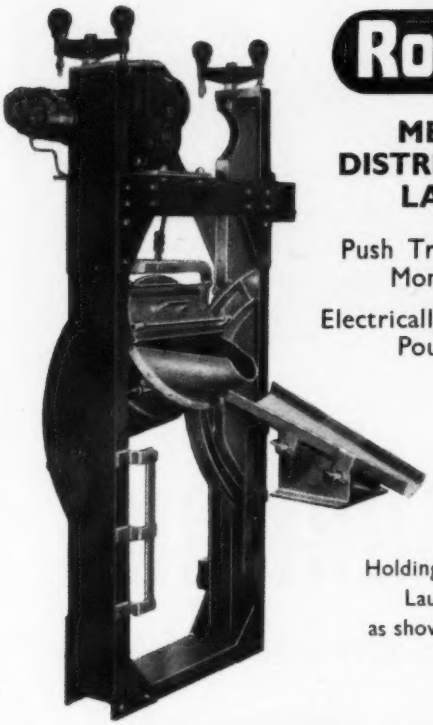

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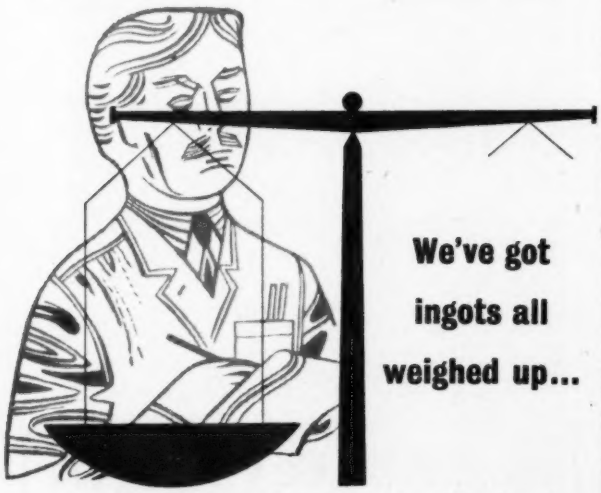

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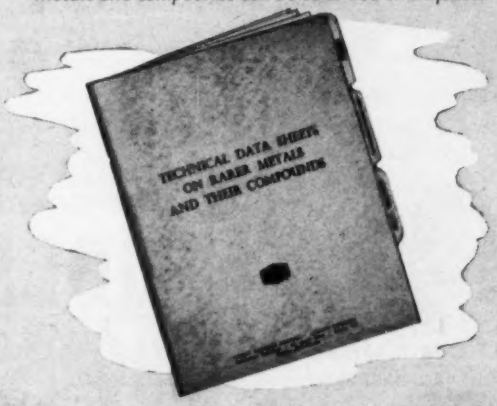


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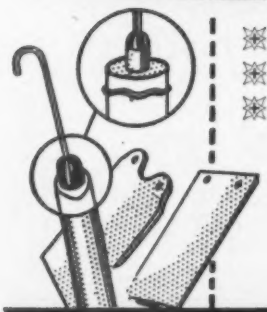

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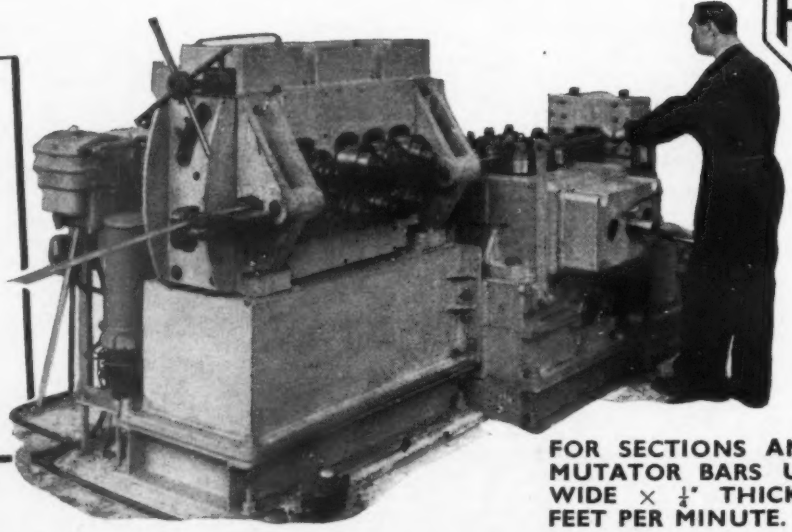

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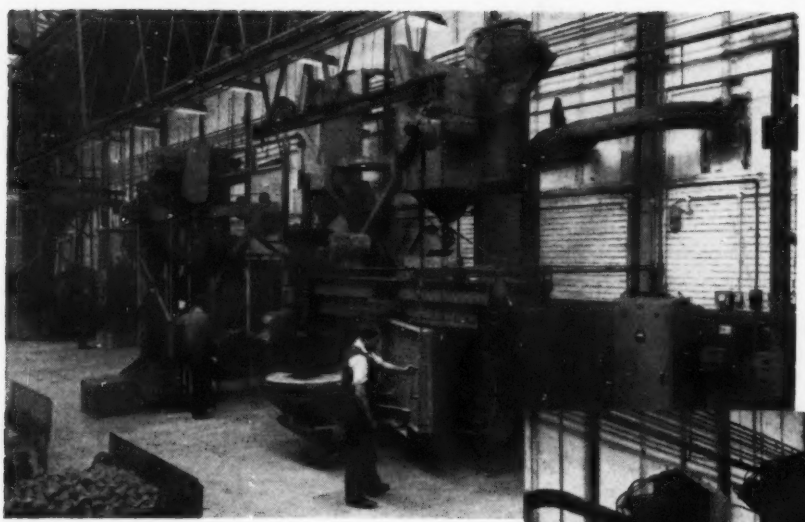

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